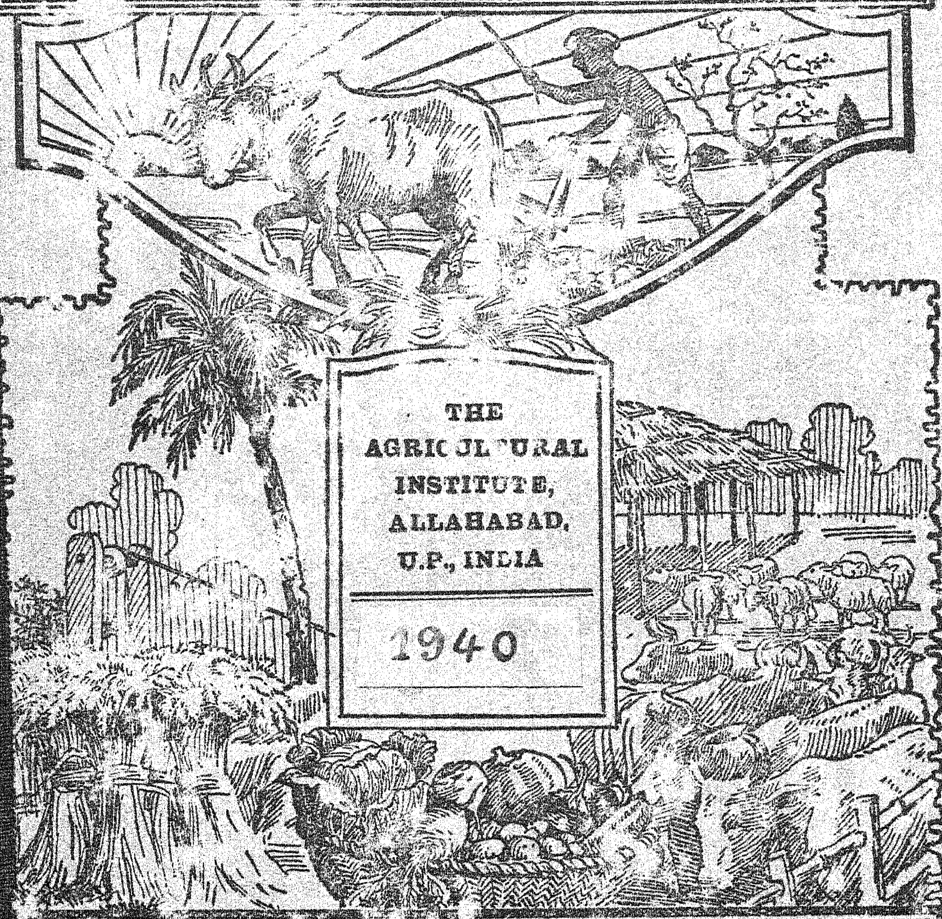
Vol. 14.

THE ALLAHABAD FARMER

A bi-monthly Journal

OF

Agriculture and Rural Life



"Plant life is a synthesis of all the sciences working together to produce the result."

JOHN M. COULTER

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MANAGING COMMITTEE

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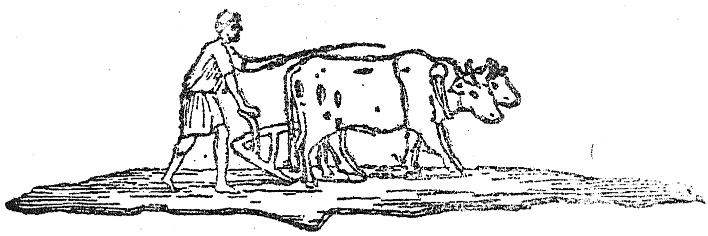


VOL. XIV] JANUARY, 1940 [NO. 1.

An Editorial.

The Influence of the Home on our Civilization

There is no doubt at all that home influences are of very great importance to an individual and consequently to the society to which that person belongs. Ideas which are inherited in childhood remain for a long time with an individual and in fact influence his mind to such an extent that his later life and even his destiny is shaped according to those ideas. A recognition of this fact makes one understand the importance of a good home in the society. This being the fact, one can say without fear of contradiction that one of the reasons for the backwardness of the Indian Society to-day is the lack of good and proper influences in the home during the early years of an individual.

Education and all other constructive forces at work in this country are all trying to bring about the development of an individual in his later stages of life. They however have failed to recognize the great importance of attacking the ignorance and superstition which are so universal in our home

life. It is our belief that this is as important a problem in the building up of our nation as any other problem that the Governments are facing in this country. Proper child care, proper diet, a proper understanding of the psychology of the child, a proper understanding of the economics of the home, an understanding of the ideas of beauty and comforts of the home, the science in the home: all these are so important that one can very readily understand the very great difference between a product of a village home and that of a city home. However, we do not for a moment think that all city homes are what they ought to be, or that the village homes are all full of ignorance and superstition. We however say that there is a great deal of room for improvement in the homes in this country and that in any attempt to re-organize or re-construct the village or the rurul life in this country, the problem of the village home should not be left out.

There are however in this country people who have felt this great need in our Indian Society. And, we believe, as a result of their thinking we have to-day in Delhi such an institution as the Lady Hardinge College for women where Home Science and Home Economics are taught. In the United Provinces, it was the vision and zeal of the lady missionaries of the Allahabad Agricultural Institute which has made it possible the starting in that institution of a course for women who are taught all the fundamentals which are necessary for the making of a good home. This course in home-making has now been taught for the last three years, and it is only hoped that Governments will recognize the great importance which such a course has for this country, and sooner or later come to its aid in seeing it really get established. The Institute had been greatly encouraged in this enterprise by Lady Haig, wife of the former Governor of this province, who broke the ground for a girls' hostel which is to be built out of the generous funds contributed by the friends of the Institute in America. We hope that this will be the beginning of a great woman institution in this province, an institution which will make its contribution in the building up of a new civilization in this country.

(Continued on page 23.)

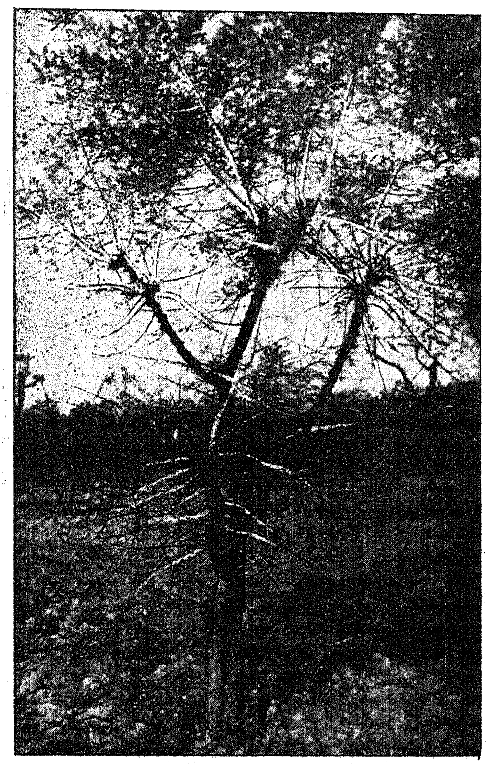
LAC CULTIVATION

BY

P. M. GLOVER, B.Sc , ENTOMOLOGIST

Indian Lac Research Institute, Namkum, Ranchi, Bihar.

The cultivation of lac, the raw product from which shellac is manufactured, is of the greatest importance to India, and is practically an Indian monopoly. Only approximately 12% of the worlds production of sticklac is produced outside India, of this roughly 80,000 maunds per annum are grown in Burma and 60,000 in Indo-China and Siam. The greater part of this ex-India production is imported into India and is manufactured into shellac in this country.



Acacia Catechu (Khair) infected with lac.

In India, lac is grown over a very wide area. The major area of cultivation is Chota Nagpur, the Feudatory States of Orissa, Central Provinces and a few adjacent areas in Bengal, and the United Provinces. This area produces 80% of the lac of commerce. Minor areas include

Assam, Nepal, Punjab, Madras, Sind etc. which contribute the remaining 80%. The annual production of lac in India during the last decade has averaged 11½ lakhs of maunds (1,150,000 mds.) per annum.

Lac is a resinous secretion produced by one of the scale insects, *Laccifer lacca*, which lives as a parasite feeding on the sap juices of certain trees and shrubs, which are known as lac hosts. The more important of these are *Butea frondosa* (Palas), *Zizyphus Jujuba* (Ber), *Schleichera trijuga* (Kusum), and *Zizyphus Xylopyra* (Ghont). The lac

Scraping lac from branches of Zizyphus Jujuba (Ber.)

insect starts its life as a minute scarlet larva under half a millimetre in length. These larvae emerge in large numbers from the bodies of the mature female insects *via* an opening in the lac cell, at certain times of the year. This process is known as "swarming" and the word "lac" is said to be derived from the Hindi word "*Lakh*" a hundred thousand, referring to the enormous number of young larvae which emerge at these times.

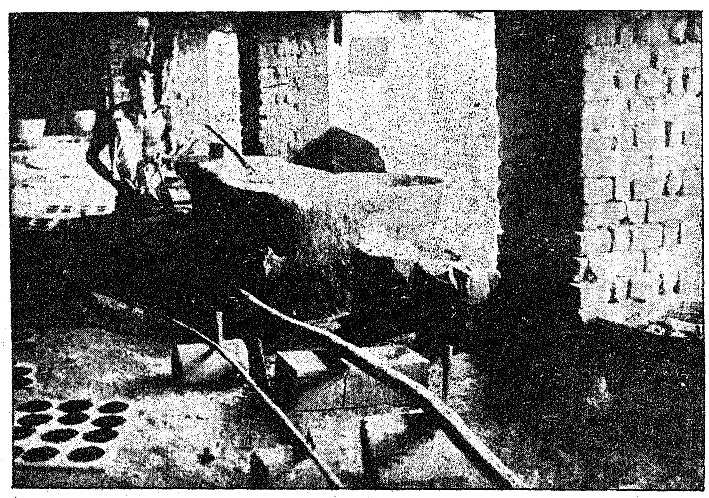
Branches of lac infected trees, encrusted with lac from which swarming is about to occur, are cut from the tree and

are divided into convenient lengths (9″-1′) which are then known as "brood lac". Brood lac is tied, or sometimes just placed among the branches of the tree on which it is proposed to produce a lac crop. This process is known as "infection" or "inoculation." Prior to infection, such trees are pruned some months beforehand to ensure their bearing the maximum number of young succulent shoots, as it is on such branches that the lac larvae perfer to settle and feed. The young crawl from the brood lac on to these young shoots, force their mouth parts which are in the form of a sucking tube, the proboscis, into the sap carrying tissues and begin to feed. As soon as feeding starts, glands

Washing lac.

in their bodies begin to produce a secretion which forms a coating over their bodies, which is gradually added to, as feeding continues. Among the larvae, roughly 30% are male and 70% female. It is the female that is responsible for the production of lac, the male constructing a small thin cell only. The female, once she has settled, never moves again; the males, however, eventually emerge from their cells and mate with the females after which they die. After fertilisation, the female cells continue to increase in size, and the cell of one female meets and coalesces with the cell of another, and in this way a continuous or semi-continuous encrustation is formed round

the twigs on which the lac insects are living. During this time the eggs which will give rise to the next generation develop in their ovaries. Finally, these eggs are laid into a space within the lac cell, formed due to the contraction of the body of the female. In this space, known as the incubating chamber, they hatch into the crawling larvae referred to previously. These larvae emerge from the lac cell by an opening known as the Anal Tubercular Pore. When the larvae have emerged, a process which takes 2-3 weeks, the females die. There are two strains of lac insect in India, the *Rangeeni* and the



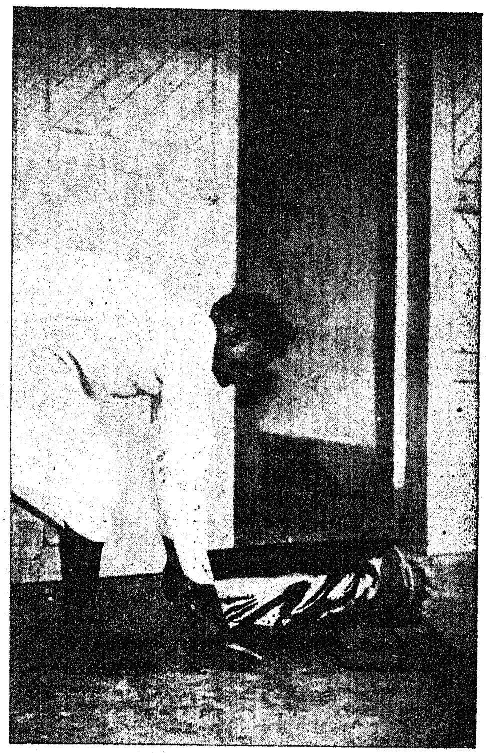
Manufacture of shellac; melting.

Kusmi, in each of which this life cycle occurs twice during the year. In the *Rangeeni*, the cycles are uneven, the '*Katki*' cycle (June-July to October-November) taking 3½ months and the *Baisakhi* (October-November to June-July) 8½. In the *Kusmi* strain, the cycles are each of six months and are called the *Aghani* or *Kusmi* (July-February) and the *Jethwi*, (February-July).

The lac bearing branches are cut from the trees and the lac encrustation is scraped from them by means of knives. If

the lac has been cut immature and the insects are still alive, it is known as '*ari*'; if swarming has occurred, it is known as '*phunki*'. This lac scraped from the sticks is known commercially as "stick lac".

Stick lac on reaching the factory is further crushed and is washed in large concrete tubs, to remove impurities and to extract the red coloured lac dye. The resulting product is called "Seed lac" or *saf chowri*. A certain amount of seedlac is exported without further treatment and is used chiefly to make bleached lac for the preparation of high grade varnishes and lacquers. The export of seedlac has been on the increase during recent years, and the chief consumer of this commodity is the United States of America.



Manufacture of shellac; spreading.

Shellac is made from seedlac by melting it in long sausage-like cloth bags 2"-3" in diameter, in front of a charcoal fire. The bag is twisted during the heating, and the pressure and heat cause the seedlac to melt and ooze through the cloth. The molten substance is removed from the bag by means of an iron spoon and is spread on an inclined porcelain cylinder containing hot water by means of a palm leaf. The sheet so formed is picked off the cylinder and is stretched by hand into a large thin sheet, which, on cooling, is broken up into small, yellow,


Manufacture of shellac stretching.

thin, translucent pieces. This is the "shellac" of commerce. Alternatively, the molten substance may be dropped in small quantities on to a zinc sheet where they spread out into circular buttons about 3″ in diameter and a $\frac{1}{4}$ of an inch thick. This is known as "button lac".

The main use of shellac is in the gramophone industry which absorbs 30%—40% of the annual output, electrical and paint and varnish industries utilise about 35%, and the hatting industry another 10%. Of the other industries using shellac, mention may be made of such diverse ones as sealing wax manufacture, photographic work, and manufacture of confectionary, munitions, grinding wheels, printing ink and fireworks etc

Research work on the cultivation of lac has been conducted at the Indian Lac Research Institute at Namkum, Ranchi, the heart of the area of major production since 1925. A thorough survey has been made of the life cycle of the lac insect of various strains and their relationship to their host trees. This together with an investigation of the bionomics of *L. lacca* has placed the Institute in a position to give practical recommendations as to resistant and healthy resin secreting strains and advice as to which host trees to utilise for the different strains during each crop. Particular attention has been paid to seasons and methods of pruning, forecasting

the date on which swarming will start, and other problems of an intensely practical nature.

Insect enemies are responsible for serious damage to the lac crops leading to a reduction in yield and deterioration of the quality of the lac produced. Two main types of enemy occur : Parasites and Predators. The damage done by the former is small, amounting to less than 5% of the lac cells only, whilst that by Predators amounts to as much as 35% and is caused by the larvae of the moths *Eublemma amabilis* and *Holcocera pulverea*. Practical control measures must be of the utmost simplicity and must cost nothing, as the cultivation of lac is a cottage industry carried out by raiyats of little education and scanty means. Controls of this type have been devised by this Institute. Recently, research has indicated considerable promise of satisfactory control by the utilisation of natural enemies of these two caterpillars, in particular, the two Braconids, *Microbracon greeni* and *M. hebtor*, and it is on this aspect of the problem that the entomological researches are at present being largely concentrated.

The Institute also carries out research work on the various existing and potential uses of lac and shellac. Mention may be made of the work being done on the uses of shellac in the moulding and varnishing industries.

The Institute is situated five miles from Ranchi the summer capital of Bihar. It stands in roughly 150 acres of land of which 85 acres comprise the experimental lac plantation. The Institute in addition carries out practical research work in a large number of subsidiary plantations through the lac growing area of Bihar run by the Bihar Forest Department. The Institute has its own electric light and water supply, and an experimental lac factory, and is fully equipped for research work on all aspects relating to the growth, manufacture and uses of lac and shellac.

For a detailed account of the cultivation of lac the reader is referred to "Lac Cultivation in India" and of its uses to "Uses of Lac", both published by the Indian Lac Research Institute and obtainable from the Director.

HINTS ON POULTRY FARMING IN INDIA

BY

A. E. SLATER,

Mission Poultry Farm, Etah, U. P.

Introduction.—Several requests having recently been received from Rural Development Officers and others asking for information and what we advice in regard to the improvement of village poultry, this note has been prepared in the hope that it may prove useful.

The recommendations made in it are based on the methods followed at the Mission Poultry Farm, Etah, U. P. which has been running successfully since 1912, and its five branch (village) poultry farms, in the districts of Etah, Mainpuri, Fatehgarh and Etawah.

What is here advocated we know from experience will succeed if the work is carefully supervised for, for many years the largest poultry show in India has been held annually at Etah, the exhibits of pure bred fowls all village bred, numbering from 1000—1500 and at the annual village poultry shows, we have had village exhibits of 300—800 pure bred poultry.

The methods recommended as to housing, care and management; feeding, prevention of disease etc.; are those followed on the Mission Poultry Farm and its branch farms, and which in our hands have proved practicable, simple, efficient, and inexpensive.

How to introduce improved Poultry in villages?—For the development of a village poultry industry throughout the country, it would be desirable to follow the method that has worked successfully in the Etah district and the adjoining districts. We would recommend the establishment at suitable centres such as district headquarters, of small but efficient demonstration poultry farms where the

advantage of modern methods of housing, prevention of disease, pedigree breeding, feeding, hatching and rearing could be demonstrated.

Linked up with these demonstration centres there should be as many simple village poultry farms, in selected villages as may be deemed desirable. It would be best to have but one purebred variety kept at each village centre. Purebred eggs for hatching to be sold from these village centres at the rate of one anna per egg. To foster the industry an annual village poultry show should be held at each village centre and assistance also rendered in marketing the produce. To keep up the quality and stamina of the fowls kept at the village centres, fresh stock from the central demonstration poultry farm should be provided as necessary.

Cost of stock and housing.—The following suggestions are made as to costs, both non-recurring and recurring, for a unit for a village centre consisting of one allmetal tick proof house 6′×4′×4′, yard and a pen of 10 purebred fowls. A non-recurring grant of Rs. 250/-; cost of 10 fowls Rs. 100/-; cost of runs and equipment Rs. 110/-; allmetal poultry house Rs. 40/- and a recurring grant of Rs 250/-per annum for the maintenance of the fowls, pay of attendant and other petty expenses are required. It may or may not be thought desirable to establish small demonstration poultry farms at various district headquarters. This factor will probably be determined by the amount of money it is proposed to spend on poultry improvement, but if such a farm be contemplated it may be made up of one or more units, the cost of one unit having already been mentioned. If systematic rural improvement of poultry is sought, then in my opinion the village centres are the more important if both cannot be afforded.

Improvement of local breeds.—Another method of village poultry improvement advocated by a good many is that of crossing and grading up the cross-bred hens. To do this all desi males in the village should first be given up being exchanged for purebred. White Leghorns, Black Minorcas or Rhode Island Reds. Naturally only one of

these breeds should be chosen and not all three. The cross-bred females are then mated, again to a purebred cock, of the same breed used in the first cross. All cross bred males must be got rid of, for to mate the crossbred females back to a desi or cross bred cock is simply going backwards, and accomplishes nothing. If this method of crossing the cross-bred hens with a purebred male is systematically carried on for about 5 years, the hens at the end of that time will be over 99% pure. This method is known as grading.

The first cross shows a great improvement. The hens are much better layers of larger eggs than the desi ones, and in case Rhode Island Red males have been used, larger also.

Local conditions must determine whether to use Leg horns, Minorcas, or Rhode Island Red cocks. If eggs are the prime requisite. Leghorn or Minorca males may be chosen. If table fowls of large size are desired Rhode Island Red males may be used

Which of these two methods should be chosen. The keeping of a pen of pure bred fowls in a village centre and selling purebred eggs for hatching or the distribution of pure-bred males in the villages to be used for crossing on the desi hens. The choice is again determined by local conditions.

If there are but a few families keeping fowls in that particular village and it is easy to persuade the people to get rid of all the desi males they have, so that these will not be a constant source of danger to the purebred fowls they raise then, we advocate the keeping of purebred fowls, as the villager can more readily earn more by this means. Should however the village be a large one, say with a large Mahommedan community keeping many fowls, then probably the crossing and grading method will give better results, as it will be difficult to persuade all the people of the village to give up all their desi cocks.

Coming now to the procedure to be followed in the village two main lines of improvement are open. Purebred poultry can be kept at the village farm, consisting as has been suggested, of a unit made up of an all metal tick proof house,

a yard and ten purebred fowls, 9 females and one male. Eggs for hatching can be sold to villagers at-/1/- per egg and they can be encouraged to go in for purebred poultry. That purebred fowls can and do thrive in the villages has been established without any doubt. Only one breed in one village centre should be kept Certain breeds are hardi r however than others and after years of testing varieties the Mission Poultry Farm has found that White Leghorns, Black Minorcas and Rhode Island Reds all do well. Leghorns and Minorcas are "par excellence" "egg breeds" and are hardy, active, and vigorous, non setters and excellent layers. Their eggs have to be hatched under desi hens for the "broody" instinct has been bred out of them. Rhode Island Reds are well known as a "general purpose breed", *i.e.* they are a "dual purpose' fowl, combining excellent table qualities with heavy laying. They are large handsome fowls, hardy and vigorous, and in much demand by the public. They however, being large fowls consume more food than do Leghorns or Minorcas.

Prevention of disease.—This is most important. It is my opinion from long experience, that the fowl tick whose bite causes "tick fever" or "spirochaetosis" is the cause of the greatest loss, and the reason for most amateurs giving up poultry keeping. Poultry are of course subject to many diseases, and in recent years the dreaded "ranikhet disease" or "fowl influenza" has caused great mortality, but the fowl tick is the arch enemy, because but few people seem to be conversant with it, or with "tick fever". This is one case where prevention is much better than cure. Complete eradication of the tick is not difficult if the "all metal" poultry houses which I have advocated be used, and if these be thoroughly burnt out occasionally. Tick proof perches placed in any house are advocated by some, but these are not nearly as satisfactory as tick proof houses. Menials are liable to forget to fill the little oil containers on the tick proof perches with oil. The tails of some of the birds may touch the sides of the house, and ticks thus gain access to the fowls for they prey on them at night, secreting themselves during the day in deep cracks etc., and the owner is quite unaware of their existence.

Some fowls refuse to use the perch. It is thus far better to instal the "all metal" house. The writer in 1912 had heavy losses from tick fever. He like most amateurs mistook this disease for fowl cholera, as the symptoms in both cases are very similar, and it was the microscopic examination of the blood which revealed the "spirochaete". When he wrote to the Governments of the U. S. A., Australia, and S. Africa for treatment etc. of tick fever, the replies stated, that in each country the keeping of poultry by the farmers had almost to be given up because of the losses caused by tick fever, and it was only when the all metal houses were put into use, that the disease could be adequately controlled. This the writer did, and has used such houses ever since.

Many people connot even recognize the fowl tick, but confuse it with lice, mites etc. It is a large insect, considerably larger than a bed bug which it resembles somewhat. It feeds only at night so the adult tick is never found on the fowl, but in its larval or nymph stage it is found attached to the fowl and appears as numerous little round black spots about the size of a pin head firmly imbedded in the skin.

The symptoms of tick fever are green, yellow, and white, pasty, loose motions; great prostration; loss of the use of the legs, drowsiness, high fever. These symptoms are the ones found in fowl cholera also, which I believe to be a very rare disease. Tick fever can be cured in the very early stages by hypodermic injection of Soamin, or Salvarsan, neosalvarson, 606 aloxalate of mercury and so on. To expect the villager to do this is hopeless, but to eradicate the tick through the use of all metal poultry houses, which are thoroughly burnt out, is quite feasible and in this way this dread disease may be prevented. The writer receives more enquiries about this disease from poultry keepers than about any other and in his opinion tick fever is what causes amateur poultry keepers to get discouraged and entirely give up the keeping of poultry. Desi fowls are just as subject to this disease as crossbreds or purebreds. Ticks must be controlled.

Feeding.—The greatest mistake made in feeding, is that too much grain is usually fed, and not enough animal

and vegetable food. It must be remembered that the "jungle fowl" from which all breeds and varieties of poultry have been evolved, finds very little grain in the forests. Its food consists mostly of insects and green growing shoots, the only grain usually being some weed seeds. The following method of feeding fowls has been practised on the Mission Poultry Farm, for many years and is cheap and has given satisfaction. If offal, *i. e.* "ratab" is not available, the animal food so necessary can be given in the form of sour milk, "dahi" or butter milk. Both are very good. If heavy egg production is looked for some form of animal food must be given to provide the protein as eggs are rich in this.

The method used on the Mission Poultry Farm, Etah.—"In the morning a feed of grain composed of wheat (gehun), maize (makka), and great millet (juar), about equal proportions of each, one handful to each fowl, *i. e.* about 2oz. If the birds are not on free range in order to induce exercise the grains should be scattered in a litter of dried leaves, dried grass or bhoosa, etc. about 6 inches in depth to keep them scratching for it.

At noon they get all the green food they can eat which in the winter consists of such things as cabbage leaves, cauliflower leaves, chopped lucerne etc., or whatever is available from the vegetable garden. Doob grass if available is also very good. They will usually eat about 2 oz each of green food.

In the evening I give a moist mash, all they can eat which will again be about 2 oz. for each fowl. The mash is made up as follows:—

1/3rd cooked minced meat. I buy from the slaughter house what is commonly known as "ratab" (paunches, lights etc.) This is a non-stimulating white meat and very nutritious and can easily be bought for-/-/6 or-/1/-per seer. 1/3rd of cooked vegetables using whatever is available. Pumpkins, turnips and onions etc. are all good. I use whatever is in season and easily procurable. 1/3rd of *atta* consisting of a mixture of wheat *atta*, and *bejhar* ka atta, in about equal

proportions. The minced meat, cooked vegetables, and *atta* should all be thoroughly mixed and fed in a moist and crumbly condition *i. e.* not sloppy; a little practice will enable one to know how much water to use, and the same water in which the meat and vegetables are cooked in, is the best.

HATCHING AND REARING.

The best months for hatching are from October to February. If this is done the chicks are of good size, strong, and robust by the time the hot winds commence in April. They will also be found for less liable to contract chicken pox if hatched early, *i. e.* in the Winter or early Spring. The village poultry keepers invariably hatch too late thinking that the eggs will chill and not hatch well, if hatched during the winter, but this is a mistaken idea. On our farm here we commence to hatch in October and complete all our hatching by the end of February. The following hints will be found useful:—

HINTS FOR REARING & HATCHING OF BABY CHICKS.

1. Set the hen at night in a well ventilated semi-dark place apart from the other fowls.

2. Do not place more than 7 eggs under a country hen.

3. Use a nest box without a bottom, make the nest on the ground; scoop out the earth to saucer shape, and line the hollow thus formed with cut straw and tobacoo stems or leaves.

4. Before setting, examine the hen for insects and if found, dust with a good insect powder. A hen covered with vermine sits badly, and in due course the chicks also become infested and do not thrive, the result often being fatal.

5. Make certain that the hen comes off the nest daily to feed and that she is provided with maize, fresh water, and a dry dust bath. She may remain off the nest from 10 to 20 minutes, according to the season of the year. Cooling the eggs daily is most important.

6. Leave the hen alone at hatching time.

7. Do not feed the chicks till from 48 to 72 hours after hatching. Allow them to absorb the yolk.

8. If available give them sour skim milk or butter milk to drink from the first.

9. First feed with rolled oats or stale bread crumbs with hard boiled eggs, boiled for thirty minutes, in the proportion of six parts of the former to one part of the latter. Mix in shell and all. Feed six times daily in small amounts about one ounce per day to 12 chicks.

10. After three days begin feeding with a good chick feed. A mixture of crushed wheat, maize (makka) equal parts with a little cracked rice is good.

11. Gradually increase the amount of chick feed continuing it until the chicks are old enough to eat whole or coarsely cracked grains.

12. After ten days, feed a bulky moist mash consisting of boiled vegetables, dried off with a good poultry meal. Feed with mash twice daily and chick feed three times.

13. When one week old green food must be given, Lettuce, cabbage, lucerne, sprouted oats or barley are all good. Chop it fine. Minced meat must also be given. For best result try white ants. Nothing is better.

14. When four weeks old feed four times daily and when eight weeks three times daily. Always give chick feed or grain in litter and make them exercise. Never feed on bare floor.

15. Feed as much raw or cooked vegetables at all times as they will eat.

16. Close confinement, poor ventilation, and feeding largely on grain and not on mash will never produce husky vigorous stock.

17. Dust chicks with insect powder. Oil boxes and perches with kerosene. Avoid overcrowding.

MILK AND NATIONAL HEALTH

BY

M. P. KEDAR, I.D.D.

'The strength of a nation,' observed Benjamin Disraeli, a former Prime Minister of England, 'depends on the health and strength of its individual members. It matters not how wealthy a nation may become, how large its cities, how vast its armies and navies, if the health of its people is on the decline, it will rapidly decay and perish.' National health as a matter of fact is having foremost consideration in all civilized countries in the world. Col. A. H. Russell, Health Commissioner of India, in the course of a broadcast talk from the Delhi Radio Station, said that modern public health development stood for the creation and maintenance of all the conditions which would enable each individual to grow into a healthy and happy citizen. He added that the purpose of all nation-building activities was to make the lives of citizens fuller and richer than it had been.

There are, of course, many factors which influence the mental and physical health and general well-being of the people, but certainly diet is the chief among them, for it is on this that normal health and vitality of every nation largely depends. Col. Russell rightly pointed out that 'an adequate state of nutrition is of the greatest importance, not only in the prevention of disease, but also in increasing man's resistance to infection and his sense of well-being'. In this respect the following statement of Dr. J. Oldfield, senior physician to Lady Margaret Hospital, Bromley, is of special interest :

Why do I emphasize the question of food as being so important for health, and through health for happiness ? Why do I lay so much stress on the food that is eaten, and leave unnoticed the thousand other causes which make for health or disease ? I do so deliberately and of set purpose,

because I find that it is from the food we eat, and the drink we drink, that proceeds the strength and vigour of the body and of the mind, and of the power to manifest the soul.

Health, indeed, is the greatest national asset and to safeguard it every unit of the society must be provided with adequate supply of food—food that should nourish the body properly and protect it against all kinds of abnormalities and disease. In fact, building and maintaining of permanent good health is very largely a matter of correct diet.

RESULTS OF EXPERIMENTS.

The modern world is looking to prevention rather than cure as the greatest agency in improving and maintaining the efficiency and virility of the people. 'The Medical training of the present day,' says Prof. G. Woodhead, M.D., of Cambridge University, 'is directed much more closely to the prevention of disease than it ever has been before.'

Most of the diseases and physical abnormalities are directly traced to wrong or inadequate dieting. 'Seventy-five per cent. of the most terrible diseases,' observes Dr. Alexander Haig, 'under which we suffer (they are not, in fact, diseases at all, but poisonings by unnatural foods), our increasing insanity, our increasing cancer, our debility, and deterioration, may be due, not improbably, to the neglect of Nature's teaching.'

Defective diet as pointed out by Dr. Thomas A. Darlington, Health Commissioner of New York City, has produced in the experimental colonies such abnormalities as short and stocky form, enlarged joints, defective teeth, hair of poor quality, nervousness, general runtiness, unusual timidity and other symptoms. In both the mature and the young stock these defects have appeared. However, it has been found that when the same animals are given a liberal allowance of milk they grow rapidly, attain a large size, have bright eyes and fine coats, and give every evidence of excellent health and great muscular power.

We must bear in mind that our usual diet which consist chiefly of bread, pulses and vegetables, meat and fish, supplemented by a little of *ghee*, that too mostly of the vegetable origin, and some sugar, jam, etc., is deficient in many respects, especially in certain mineral elements and most of the vitamins. 'It is beyond doubt,' wrote Sir Edward Mellanby in the course of an article in the *Times*, London, that, if these dietetic defects were made good, especially in the rising generation, better physical and mental health would result, much sickness and physical disability would disappear, and the need for doctors and hospitals would be greatly reduced.'

Mankind, however, has been blessed with a few articles of food among which milk and milk products have the foremost place, which are rich in these so commonly missing elements—the mineral matter and vitamins - and serve as 'protective foods'. Sir E. Mellanby observed : 'If a sufficiency of these protective foods is not eaten, poor physical development and certain forms of ill-health would result' According to him protective foods include milk and other dairy products, eggs (essentially the yolk), vegetables (especially green vegetables), liver and other glandular organs, fat, fish, fish oils (*i.e.*, cod liver oil) and fruit.

Ideal Food

Milk is the right and ideal food to make up all the common deficiencies of a failing diet. A report recently issued by the British Ministry of Health's Advisory Committee on Nutrition says : "It is in the 'protective food' that deficiency (in diet) is likely to be met, and first upon the list of protective foods comes milk. It is generally agreed that one pint of milk per head per day is advisable." The Committee on Nuritional problems of the American Public Health Associations also stresses in a recent report that inasmuch as the evidence now available shows so plainly that vitamin A, in quantities larger than are needed to support growth and prevent deficiency disease, is an important factor in health in that it increases the ability of the body to resist infectious disease, the supply of butter as well as of milk becomes a matter of importance to health through nutrition The

League of Nations Committee on Nutrition also authoritatively points out that 'milk is of outstanding importance. . . because of its high protective value'.

It may be recalled here that the health or life-promoting process requires a great amount of alkaline environment in which it functions, while the disease or death-promoting process is of the acid nature. Since milk is one of the richest sources of alkaline matter it has a special value as a promoter and protector of health. Dr. H. C. Menkel, M.D., observed that the body needs raw materials in the ratio of four parts alkali and one part acid. 'Fruits, vegetables, and milk,' he said, 'provide all the alkalies for a healthful living, while meat, fish, fowl, eggs, wheat, rice; leave the excess of the acid residue.'

Since milk is the most dependable food source of vitamins and other high properties and serve ideally as a 'protective food', it provides one of the best safeguards of national health. A report of the Committee on Nutritional Problems of the American Public Health Associations stated:

Statistical analysis of the data of a large number of cases shows clearly that the improvements in health were certainly due to the increased proportion of the milk in the diet—that they cannot have been accidental, due to the chance or physiological variability of the animals. And all of the improvements in health and vitality were even more clearly marked in the second generation than in the first. Thus a higher milk consumption makes a higher degree of health both in the present generation and their offspring.

Observations of physicians and health welfare organizations in different parts of the world have definitely shown that people who do not use milk in their daily diet are invariably inclined to under-nourishment and are more susceptible to infection and chronic ailments. Unquestionable statistics have further proved beyond dispute that in communities where plenty of milk is consumed, the proportion of illness has decreased—due largely to milk's high content of the protective vitamins and mineral matter.

Sir Robert McCarrison while discussing the question of suitable diet for the people of this country pointed out that

because the wheat-eating races of northern India are accustomed to use milk, milk products, green vegetables and fruits with the *atta*, these races are amongst the tallest, the strongest and the most vigorous in India. Those amongst them who do not take enough milk, milk products and green vegetables are, however, liable to suffer from certain diseases because the *atta* by itself does not contain enough suitable proteins nor enough vitamin A, nor enough of certain mineral salts.

He added:

Indeed, most of the cereal grains require to be eaten with milk and milk products or fish or eggs in order to provide plenty of vitamin A, otherwise they are likely to cause stone-in-the-bladder, a disease which is very common in parts of India where whole cereal grains are eaten largely by people who cannot afford to take enough milk and other vitamin-A-rich food stuffs, with them.

The statistics available in India show that there are more lepers in the southern parts of this country than in the northern. Medical men offer an explanation for this fact that the people of southern parts consume less milk than those of the north. From this it is also inferred that milk is a preventive for a disease like leprosy. The number of patients operated upon for cancer in different provinces indicates that the Punjab, C. P., Sind and Mahrashtra where people use milk in one form or other in their regular diet have the least number of cases of this disease.

The intrinsic importance of this problem has been fully realized by all nations. Mr. William Raphley in *The New Statesman* and *Nation* sometime back stressed that the British people as a nation were falling more and more easily to illness and ailment. He pointed out that Dr N. Howard Mummery, Chairman of industrial medical officers, had revealed the fact that workers insured under the National Health Insurance Act lost on an average 28 days' work a year through illness, compared with 16·5 days 15 years ago. Accordingly the cost of sickness benefit in the year 1935 was estimated to have reached a record total of £26,149,000. And the amount of medicine consumed

was said to have gone up in 12 years from 38,200,000 to 62,400,000 prescriptions a year. Mr. Raphley observed:

These figures indicate conclusively that our powers of resistance even to the so-called minor ailments—influenza, colds, bronchitis and so on—are getting more and more feeble.

In reply to what must be done to remedy this state of affairs, Mr. Raphley pointed out that 'the Minister of Health, after the most careful survey of the situation has, decided that the consumption of milk must be increased if we are not to become permanently a 'C. 3' nation, and he has the support of the Cabinet in his campaign to persuade us to drink more milk.'

During recent years many steps have been taken to reduce the incidence of illness which causes a great loss both to the individual and to the state. One of the greatest values among them has been found to be the assurance of a daily minimum supply of milk to every person. It may be concluded in the categorical statement of Dr. H. D. Kay that if the nation's dietetic status is to increase, and its health to improve so that it shall have real and abounding health, and not the mere absence of the more obvious symptoms of disease, it must drink more milk and consume larger quantites of dairy products.

Editorial

(*Continued from page 2.*)

Agricultural Economic Conference

The All India Economic Conference will be held in Delhi from the 24th February, Sir Malcolm Darling, President of the Indian Society of Agricultural Economics, will preside and Kunwar Sir Jagdish Prasad, Education Member, Government of India, will open the conference.

We hope that the economists who will attend this conference will help bring new light on the difficult problems which face the Indian farmer to-day. The problem of price control, and the difficult problem of economic depression which generally follows the period of war, are some of the subjects which we hope will be discussed thoroughly, and that out of these discussions something useful may come out.

SOME ASPECTS OF FEEDING MILCH COWS

BY

ROSHAN LAL TANDON, B SC., (HONS.), M. SC. TECK.

During the last decade much attention has been given to the systematic rationing of milch cows and definite standards of feeding for maintenance and production have been laid down as guides. Much success has been obtained from these but certain limiting factors which effect the yields of an animal require special consideration.

These are: –

1. Control of digestible fibre.
2. Control of total amount of food fed.
3. Preparation of a cow for her lactation period.

Large quantities of indigestible fibre may have a very depressing effect on high yielding cows because a large amount of energy is wasted in attempting to digest the crude fibre.

Control of the bulk of ration is again necessary for the high yielding cow. Bulk has usually been measured in terms of dry matter but an improvement on this is required since the dry matter is not a measure of the volume it will occupy in the stomach; weight for weight bran occupies twice the volume.

Most of our cows weigh about 800 lbs. and they can efficiently deal with only about 20—25 lbs. of dry matter at the most.

Over and above a yield of 2 gallons the dry matter fed in fodder should be reduced and the grain increased correspondingly.

A knowledge of the dry matter content of green fodder is also desireable for bulk control.

Roots and Leguminous fodders contain about 10%; Oats, Maize, Chari and Bajara 25 – 35%; Sugar Cane for fodder 40-45%; Straws 90%.

Next to bulk control the preparation of the cow for her lactation period should be given a serious consideration.

Recently it has been found that even if abundant Calcium and Phosphorus were added to rations, losses of these minerals from the body continued. This has been said to be due to the fact that it exceeds the ability of the high yielding cows to assimilate sufficient mineral nutrients from their feed to meet the heavy demand in producing the large flow of milk during the first part of the lactation period.

Later on in lactation and when they are dry it was found that they are able to build up again the store of these minerals in their bodies if fed plenty of legume hay which is rich in lime.

These experiments emphasize the necessity of supplying dairy cows with plenty of lime and phosphate by the use of legumes not only in the period of high production, but also later on in lactation and when they are dry.

A cow producing 30lbs. milk daily was fed a ration which was liberal except that it lacked calcium, it was estimated that she lost ¼ of the calcium in her skeleton, keeping the composition of milk constant.

A dry period often stops the drain of nutrients in the form of milk and increases their utilisation in the building up of the foetus. Our cattle have not reached the highest standard of yield met with in Western Countries and also our bran and straw are much richer in lime contents; it is therefore of economic importance to know whether feeding of minerals is always necessary.

Apart from a knowledge of the Chemical Composition of a food stuff which in some cases may not be a true guide, a determination of its digestibility by actual feeding trials is important to estimate what part of it is actually digested and assimilated by the animal body. The feeding standard and digestibility coefficients as worked out in foreign countries

may not necessarily be applicable to our conditions. We have different breeds of animals, different climatic effects, different quality of milk as regards richness in fat content and different fodder conditions.

An examination of the salient features of our concentrates and fodders will not be out of place. The analytical figures for protein, lime and phosphate contents are given below.

	Protein %	Lime %	Phosphate %
Cakes	30—40	1·25	2 2
Bran	14·0	0·45	2·7
Gram	20—22	0·73	0 80
Legumes hay	18·0	1·8—2·0	0·60
Oats	4·8	0·5	0·60
Wheat straw	2 6	0·50	·1—0·3
Hays	4—10	0·4	0 4
Chari	6 0	0·7	0·7
Maize	9·0	0·75	0·7
Grass (Rhodes) ..	4·0	1·6	0·59
Grazing grass ..	12·0	2·5	0·84
Grass poor	10·0	0·30	0·37
,, rich	24·0	2·47	1·0

The above table shows that Legume hay and grazing grass are the richest in lime, while concentrates are very rich in protein and phosphate.

Thus by feeding concentrates there can never be any danger of protein or phosphate deficiencies or at least one can vary the amount as required, but in the absence of Legume hay and grazing the deficiency of lime in an assimilable form cannot be made up Moreover there is a certain ratio, *i.e.* 1: 1 in which the lime and phosphate should exist in a food otherwise if one is in excess over the other proper assimilation would not take place.

SUMMARY OF THE REPORT ON THE WORK AND ADMINISTRATION OF THE COCHIN RURAL DEVELOPMENT CENTRE FOR THE YEAR 1113 M. E. (1937-38)

By

T. A. Koshy

The Government of His Highness the Maharaja of Cochin appointed Mr. J. Jesudas as Rural Development Officer who took charge of his duties on the 1st of March, 1938. Before taking charge he paid five visits to the State for selecting a proper site for the Rural Development Centre and also for preparing the plan of buildings.

The selection of the site for the centre was done after very careful investigation and study of several factors. As the report says, "A Rural Centre whose influence is to become State wide should be located in a central place easily accessible from all parts of the State. It is to be a Light House to villagers and so there should be a large number of villages round the centre. There should also be a large and responsive population in the immediate extension area—all castes and creeds and people foll wing different occupations—who will make use of and be benefited by the activities at the centre."

Taking all these factors into consideration it was decided to locate the centre at Cherpu, six miles and two furlongs on the Trichur-Triprayar Road and also on the Trichur-Karupadanna Road. Within a six-mile radius of this place there are about 17 *panchayats* consisting of nearly 50 villages.

Co-ordination of Work.—It was emphasized by the State authorities that the new Rural Development Department should aim at co-ordinating the activities of the existing departments of Agriculture, Industries, Public Health, Co-operation and Panchayat, for effective rural reconstruction.

So in consultation with the heads of these departments a detailed plan of work was chalked out. As for example in Agriculture it included:—

(*a*) Popularising better cattle, better goats, and better poultry in the villages.

(*b*) Home gardens for better vegetables and fruits.

(*c*) Maintaining one or two good stud bulls at centre for improving local cattle.

(*d*) A good poultry farm at the centre.

(*e*) Distribution of eggs, seeds and seedlings, fodder grass, manure, tools and implements, etc.

(*f*) Composting manure in every home.

(*g*) Formation of agricultural clubs for production and marketing.

A grant of Rs. 20,000 was given by the State for rural reconstruction which was allotted to five departments in order to carry on the work planned under each of them. A conference was held under the presidentship of the Minister for Rural Development at which the prepared detailed schemes were discussed and decisions were made. A committee was also appointed to prepare a scheme for marketing rural products.

Training in Rural Reconstruction—Training of rural workers in the different aspects of rural reconstruction was to be done at the Centre. Various courses were prepared to be held at different times of the year to train workers in the particular subjects of their work. These were mostly of a practical nature where the students would learn by doing. There was to be a volunteer's course for three months, apprenticeship course for village leaders and others already engaged in rural work, holidays course in cottage industries and special courses in bee-keeping, poultry farming, etc.

Establishment and Staff.—At the Centre the important buildings like library and reading room, industrial school,

etc., were constructed under the supervision of the Rural Development Officer. Besides the Rural Development Officer the staff at the Centre included a bee-expert, a poultry inspector and two trained rural workers.

During the course of the year the Rural Development Officer visited many places in the State and gave lectures and advices on rural matters A detailed scheme was submitted by him to the Government for distribution of 1000 bee-hives to the villagers.

Activities at the Centre.—An apiary with ten bee-hives was started. Four breeds of poultry were maintained and eggs were given to villagers for hatching A fruit garden was laid out in which plantain, corms and pine apple suckers were planted.

Books on subjects relating to rural reconstruction were kept at the Centre library for the use of the public. English and Vernacular news-papers were supplied in the reading room The beginning of a rural reconstruction museum was made Interesting charts and pictures and some rural products were collected and kept as permanent exhibits. Games like volleyball were played at the Centre play grounds and many enjoyed these games in the evening.

The Centre had a large number of visitors among whom were two distinguished visitors, the Diwan Sir R. K. Shanmukham Chetty and the Hon'ble A Sivarama Menon, Minster for Rural Development.

Conclusion

The report concludes that judging from the hearty co-operation and keen interest of the Heads of the Departments and the earnestness of the people of the State in rural uplift there is every hope to see a better rural Cochin in the near future.

A STUDY OF AN IDEAL VILLAGE IN THE CENTRAL PROVINCES AND BERAR.

BY

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(continued from the previous issues)

CHAPTER IV

EDUCATION OF BOYS AND GIRLS

There can be no improvement unless the people are educated. It is through education that they come to know their responsibilities. Thus knowing the importance of education, the villagers started a society called the 'Shikshnotejak Mandal' to spread education in the village. The objects and work of the Society are given below :—

Shikshnotejak Mandal (a society for the improvement of education):—This society was established in the year 1918 with the following objects :—

To, 1. spread literacy in the village,

2. give elementary knowledge of English,
3. give moral, physical and industrial education to the students,
4. open a boarding and lodging house for the students,
5. help poor and deserving students,
6. create taste for literature with the help of a library, lectures, etc
7. establish a debating society,
8. improve the health of the students by starting a Gymkhana,
9. help small scale industries and education,

10. give training in co-operation and rural reconstruction,

11. introduce cottage industries for women and girls in their spare time.

Thus, it is seen from the above objects of the society that its aim was not only to give literary education but to impart physical, moral and industrial education to the villagers, to make them the best farmers. To achieve the above objects, the society, therefore, started the following six different societies to work in different sphere. The societies are :—

1. Kisan Boarding (Farmers' boarding),
2. Kisan Mofat Wachanalaya (Farmers' free library),
3. Kisan Hanuman Vyamshala (Physical Culture Union),
4. Bal Vakrutwotejak Mandal (A debating society for boys),
5. Khasgi Kanya Shala (A girls' school),
6. Vanita Samaj (A society for women).

The ways in which society collected the money to finance the activities of the above different societies, are very interesting and will serve as a guide to those who find difficulty in collecting money for village up-lift work. No doubt in these days of distress and poverty, it is very difficult to ask for money to the already indebted villagers, but still, if one knows the art – from whom to get, how to get and when to get, he can easily collect sufficient money to finance his village up-lift scheme. The society collected the money in the following ways:—

1. As subscription from the members. Life members have to pay Rs. 50 once only, while some members pay about 150lbs. of juari, and some pay one rupee per annum.

2 As gifts from gentlemen. Rao Bahadur Patil alone gave various gifts worth Rs. 1,100.

3. As charity. This way of taking charity is very interesting. After harvesting and threshing of grains, the Secretary of the society goes to every farmer and asks for some grains as a charity which he gives to the 'Kisan Boarding'. They also take money from the '. aisa Fund'. Some other ways of collecting money are—the reading of sacred books, in performing marriage ceremonies and re marriages, for settling the litigations in the village itself, etc.

In the beginning, the society started with a capital of Rs. 159 and 35 Kudwas (*i.e.* about half a ton) of juari only. Some of the important achievements of the society are given below:—

1926—By spending Rs. 600 as pay of one English teacher, elementary English was introduced in the school.

1927—Purchased 5¼ acres of land to have a source of permanent income to maintain the prosperity of the society. It also gave some utensils worth Rs. 63-9-6 to the 'Kisan Boarding'.

1928—Gave Rs. 10 as a gift and Rs. 5-10-0 for the prizes at the time of the Nagpanchami festival to the Vanita Samaj.

1929—Spent Rs. 360-2-0 for poor students and Rs. 818 for the running of the girls' school.

1933—Sent two girls for Midwife training in the Medical School, Nagpur. Purchased 7½ acres of land for Rs. 1,148-6-0.

1934—Purchased 9 acres of land for Rs. 900.

1935—Gave some prizes to the winners of the ploughing competition which was held under the presidentship of Lady MacLingan.

In addition to these achievements, every year the society gave some help to all the above-mentioned six societies which are under its supervision.

KISAN MOFAT WACHANNALYA

(Free Library for the Farmers)

This library was established in 1923, with the object of making the villagers more literate and well informed of the things that are going on in the world. In the year of study (*i.e.* 1937) I found the following papers and magazines in the library :—

1. Navakal (Bombay, Daily),
2. Maharastra (Nagpur, Bi-weekly),
3. Udaya, (Amraoti, Bi-weekly),
4. Kesari (Poona, Bi-weekly),
5. Prajapaksha (Akola, Bi-weekly),
6. Chitramaya-jagat (Poona, Monthly),
7. Kirloskar Magazine (Kirloskarwadi),
8. Stri Magazine (Kirloskarwadi),
9. Chand Magazine (Allahabad),
10. Udyama Magazine (Nagpur),
11. Lokmanya (Poona, Daily),

In addition to these, Rao Bahadur Patil privately subscribes three English papers, namely—"Times of India," "Daily News" (Nagpur) and "Hitwada" (Nagpur). Thus the library has four daily and five bi-weekly papers and five magazines, all of which keep the villagers well informed about the industrial, political, social, economic and religious movements in India and abroad.

The office of the library is in Rao Bahadur's building, where all the papers and magazines are kept by the Secretary, every morning and evening. Anybody can go and read them and can also take them for reading at home. In order to give some thorough knowledge of a subject, there is a library which contains 287 books on agriculture, co-operation, economics, religion and some interesting novels. All the villagers have the privilege of reading these books without any subscription. In addition to this, there is Rao Bahadur

Patil's private library, which contains about 850 books on various subjects like agriculture, economics, religion, politics, etc.

Some of the important books will give an idea about the stock in the library. There, I found books like Royal Commission Report on Agriculture, Jathar and Berry's Economics, Report of the Banking Inquiry Committee, several books on rural reconstruction and organisation, almost all the works of Swami Ramtirth and Swami Vivekananda, several volumes of Agricultural Journals, etc.

I may say that, it is the reading of all books on agriculture, economics, co-operation, politics, rural reconstruction, etc., which has helped R. B. Patil to gain a vast knowledge of all these subjects. It is the study of these books which made this village boy (*i.e.* R. B. Patil), our leader in rural reconstruction and co-operation. However, his life is an ideal one and is therefore given in appendix No. 5.

In this way, the library has helped in raising the literary standard of the villagers who now can very well recognise what is good and what is bad for their progress. Every year the library is given a grant of Rs 75 to subscribe to the papers and the magazines. The work of management is done honorarily by the Manager, who is paid through the 'Vidharbh Gram Panchayat Sangh Book-Depot'.

KISAN HANUMAN VYAMSHALA.

(*A Gymkhana*).

This was opened in 1925 to give some physical training to the youths of the village. For this purpose, they had sent two of their students to the Summer Training Class of the Hanuman Vyamshala Mandal, Amraoti. After their training they used to teach all the Indian games and drill to the youths of the village, in the evening. To create some competition, they also hold an annual ceremony on the Nagpanchami festival, and give prizes to the winners of the various competitions.

In this way this institution helps in maintaining the discipline amongst the youths. The Gymkhana possesses 25 *lathis*, 25 spears, 25 *lazims*, 2 pairs of *chadi-pattas*, 25 pairs of clubs and three *malkhambs*.

KHASGI KANYA-SHALA

(Private Girls' School).

This was started in 1926, to educate the village girls, because, some of the orthodox and superstitious people did not like to send their daughters to boys' school. In the beginning Mrs. Patil (R. B. Patil's wife) worked as an honorary teacher, but afterwards the Local Board appointed a lady teacher. There are only three primary classes having about 40 girls. For the higher classes, the girls are sent to the Boys' Middle School.

SHIKSHNOTEJAK BOOK-DEPOT

(Educational Book-Depot).

This was opened in 1926, to supply all the books and the necessary stationery to the students at a cheaper rate. Every year, on an average, the depot gets about Rs. 50 as net profit. This profit is utilised in supplying books and prizes to the poor and deserving students in the school. In the beginning the capital of Rs. 200 was given by R. B. Patil without any interest By this time all the capital has been repaid and the depot is now running on its reserve fund. One teacher, who is in charge of the depot, manages the whole affair.

BAL-VAKRUTWATEJAK MANDAL

(A Debating Society for Boys).

In order to make the students bold and good speakers from the very childhood, this society was started in 1926. Every week a meeting is held in which some students are

asked to speak on some interesting subjects. Annually they also hold an elocution competition in which a prize is given to the best speaker. Sometimes, some experienced men are also asked to speak on subjects like co-operation, sanitation, health, etc., and to advise the students. In this way the society helps the mental development of the young boys, who are going to be the village guides.

VANITA SAMAJ

(*A Ladies' Society*).

This was started in 1932 by Mrs. Patil, to organise the women of the village and to give them some understanding of their duties. For this purpose, a general meeting of all the women and girls is held on every women's festival, and various games, dramas, dialogues, etc., are arranged on the occasion. To encourage the women and girls, prizes are given to the winners of the different competitions.

KISAN BOARDING.

This institution is meant for the lodging and boarding of the students of the school, who come from distant villages. Its opening ceremony took place under the presidentship of Mr. Bhawalkar, Deputy Inspector of Schools, Daryapur, on the 15th May, 1926. The management of the boarding is under the guidance of the 'Shikshnotejak Mandal'. The Mandal appoints a teacher as superintendent who looks after the students and trains them to improve their moral and physical conditions. The boarding runs chiefly under the kind patronage of R. B. Patil who, alone, has donated Rs. 2,600 as help at different times whenever the boarding was in need.

The chief aim of the boarding is to enable the poor farmers of the surrounding villages to send their sons to the school. No room rent is, therefore, charged to any student, and the cost of boarding is also kept very low by introducing a simple and cheap system of diet. The expenditure of

the boarding is taken either in cash or in kind. Average expenditure per month comes to about Rs. 3 only. The following table gives some idea about the number of students, their average monthly expense (meal charges only) and the examination results for some of the years.

Year.	Total No.	Free Students.	Paid Students.	Average charge for a month.	No. of students passed.
				Rs. a. p.	
1926-27 ..	20	5	15	3 8 0	19
1927-28 ..	34	5	29	3 8 0	34
1928-29 ..	57	6	51	3 4 0	54
1936 37 ..	11	4	7	3 4 0	10

It is seen from the above table that the number of students in recent years has decreased. This is not due to any lack of facilities than before or any other troubles, but is due to the economic depression of the farmers and more so due to the opening of other Anglo-Vernacular Middle Schools in the surrounding villages. However, today, the state of affairs can be improved by introducing an industrial and agricultural education in the school. This type of education is the crying necessity of rural India, and will attract students from all over the Province.

Appendix No. 5

A short sketch of Rao Bahadur U. S. Patil's life.

There are hundreds of Rao Sahibs and Rao Bahadurs in India, but very few have done any substantial improvement in promoting the real cause of their country. To them therefore the following account of the life of this 'Karmavir' will serve as a guide.

Childhood: – He was born on the 14th November, 1896. His father was the Patel of the village and was fairly rich. He left this world when this little 'Karmavir' was only two

years old. Under these circumstances there was no proper man to look after the estate and his maternal-uncle therefore took its charge. It was in the noble company of his maternal-uncle that his character was built. The maternal-uncle, who is universally known as 'Mamasahib', is a thorough and very wise gentleman. In the very childhood, he gave him good lessons of citizenship and public welfare. He received his primary education in the village school, when he was always kind towards his poor friends, and mixed freely with them.

Beginning of public life :—After passing his Matriculation examination in 1917, he came to his village and studied the condition of the villagers for a year. Then knowing thoroughly that no improvement can be effected, unless the people are educated, he started the 'Shikshnotejak Mandal' in 1918, which now looks after all the educational activities in the village. Again in 1922, the 'Kisan Stiti Sudharak Sanstha' was started to improve the condition of the farmers. During this period, he used to call a meeting of the villagers and discuss with them the way of their improvement. Knowing that the future of India does not depend only on the improvement of one village, he extended his public activities to other villages in the Province by starting the Panchayat movement.

Some of his achievements:—Government steadily watched his success and appointed him an Honorary Magistrate in 1924. He started propaganda for the establishment of Village Panchayats in the Province and prepared the best Panchayat Laws which are well known all over India. He is so much well acquainted with the Panchayat business that he is called as 'Non-official Panchayat Expert' in the Province. He is an Honorary Secretary of the 'Vidharbh Gram Panchayat Sangh', and has kept the head office of the Sangh in his own building. Any information regarding Village Panchayats which cannot be obtained even in the Secretariate of any Province can be obtained from the Panchayat's office in the village.

He has given his own building for the offices of the various societies, and also has given hundreds of rupees to

facilitate their working. In one of the Provincial Sessions of the Panchayat Sangh, of which Diwan Bahadur Bramha was the president, public bestowed upon him the most honorable title of 'Karmavir' for his achievements. He is a man of patriotic spirit which can be seen from the fact that, he gave the resignat on of his Magistrateship in the Civil Disobedient Movement in 1930.

He was an active member of the Provincial Legislative Council for continuous nine years, during which time, he introduced several bills for the improvement of the farmers. In 1932, Government honoured him by bestowing the title of Rao Sahib. In 1936, he was again given the powers of Honorary Magistrate. In 1937, he was given the title of Rao Bahadur.

He is the pioneer of introducing the system of 'Single Mark Boundary' in Berar in his own village. For many years he was a member of Local Board, Central Bank, Provincial Bank, District Board and was the President of the Land Mortgage Bank and the District Council, Amraoti. He was also a member of the Retrenchment Committee, Finance Committee and a delegate to the All-India Cattle Conference. During his presidentship of the District Council, he did several remarkable improvements, some of which are given below:--

1. The first and the most important improvement is the introduction of 200 'Cheap Type Schools' in the district.

2. Prepared a directory of all the school teachers and gave their due increments, which were not given for the last so many years.

3. Arranged for good roads and water supply in villages in the district.

4. Introduced 'Travelling Libraries' for the villages.

5. Arranged for 'Travelling Hospitals' and opened some permanent dispensaries in some villages.

6. Introduced compulsory primary education for boys and girls.

7. Opened some Industrial and Agricultural Schools in the district.

All these achievements of the Rao Bahadur, only at the age of 42 years, certainly go to prove his sympathy for the public and interest in the National prosperity. If every Rao Sahib, Rao Bahadur and a rich man in a village will try to follow the path shown by this 'Karmavir', within five years then, we shal. surely be abie to see our country at a fairly high level of improvement.

CHAPTER V

Village Administration and the Village Panchayat

As this is a Ryotwari village, the Patel is the headman of the village. He is a representative of the Government, and looks after the whole administration of the village. His most important duty is the collection of land revenue from the farmers. In this work, he is assisted by a man known as 'Kulkarni' or 'Patwari' who maintains all the revenue records of the village. There is a third man who is always from the depressed class and is known as a 'Mahar' or a 'Kotwal'. All the above three posts are hereditary. In this way the administration in a Ryotwari village is carried by the above three men. But as there is Panchayat in this village, most of the useful work is done by it.

The Village Panchayat

The Panchayat started in 1925, and now is one of the best Panchayats in the Province. At present, there are 15 membe s, representing all the communities in the village. Weekly meeting of the Panchayat is held on every Wednesday. During the year 1936, they held 54 meetings. In these meetings they discuss all the small crimes and Civil Suits upto Rs. 200 and give their decision. They have got the power to fine upto Rs. 20, according to the seriousness of

the crime or suit. They have also got the powers to look after sanitation, water supply, health, bazar, cattle-pond, etc., of the village and to improve them.

In short I may say that if the Sarpanch (*i.e.* the President) is a wise man and known when and how to use his powers, then the Panchayat can be a chief governing body of a village in all the social, religious, economic and political affairs. This is quite clear when one looks to the list of the work which this Panchayat has done during only one year, *i.e.* in 1936-37,

1. A well has been dug on the Babhali Road to supply water to the travellers.

2. Prepared a scheme and made arrangements for supplying water for the year to the village cattle and to the depressed class people.

3. Every week, poured phenyle and kerosene in gutters in the village.

4. Made special arrangements for women, by making some laterines in a field which was taken on lease.

5. Supplied medicines to the villagers in epidemics and usual sickness.

6. Requested the District Council to sanction 2/3 of the amount required for digging a tank.

7. Asked the villagers to put all manure in separate pits and not on the roads.

8. Repaired the Dharamshala.

9. Excavated a pond, and dug some wells around it to supply water.

10. Asked all the villagers to clean their surroundings by removing grass and other weeds.

11. Invited a veterinary doctor for the inspection of the village cattle and for castrating the male calves of one to two years old.

12. Removed all grass and weeds from the public roads at the cost of the Panchayat.

13. Took preventive measures for cholera by putting different boards and by adding potassium-permangnate in well after every week.

14. Brought a doctor who inoculated 620 men.

15. Prepared a square of 'H' iron for the *moht* on the public well.

16. Kept some servants to watch the sanitation of the village. If they find anybody committing nuisance on a public road or a place, they were given As. 2 as a prize for detecting the case.

17. Supported the unemployed labourers by giving the work of preparing good roads. In this way 13 different roads leading to the surrounding villages repaired.

18. Requested the Government to give a piece of land under the Land Acquisition Act, for digging a tank.

19. Distributed prizes worth Rs. 5 in the Bairam Agricultural Exhibition.

20. Observed the 23rd Oct. as the Panchayat Day on which a general meeting of the villagers was called. In this meeting the work of the Panchayat during the last year was explained and also the budget for the year 1937-38 was read. Last year the Panchayat spent about Rs. 2,400 on different kinds of public work in the village and prepared a budget of Rs. 3,497, for the next year, *i.e.* 1937-38.

21. Made arrangement for informing the farmers about the daily rates of cotton in the cotton market.

22. Put different boards on the boundary of the village and on roads, showing the reserved area of the sanitation.

23. Gave donation to the library, gymkhana, and Scout Committee of Rs. 5 each, and of Rs. 10 to the tournaments of different Indian games.

24. Repaired the well which supplies water to the cattle, and built new watering tanks.

25. Built one special watering tank (10X3X2 feet) for sheep and goats.

26. Paid annual subscription to the Vidharbha Gram Panchayat Sangh.

27. Repaired the well in front of the Dharmashala.

28. Sent three members of the Panchayat on the School Committee.

29. Kept prizes for the tournaments of the District Council in which the Itki School got the Championship.

30. Sanctioned the water tax for the year 1937-38.

31. Asked the farmers not to erect the heaps of their Kadbi within 50 yards of the village.

But with all these advantages of the Village Panchayat, there are only 946 Panchayats in the Central Provinces & Berar. While in Baroda and Mysore States, there are 3,000 and 9,000 Panchayats respectively. All the accounts of the Village Panchayat are most up-to-date and are checked by the auditor and the Sub-divisional Officer, once a year. During the year 1936-37, the income and expenditure of the Panchayat were Rs. 968-3 3 and Rs. 953-9-8 respectively, leaving a balance of Rs. 14-9-9 for the next year.

CHAPTER VI

OTHER SOCIETIES AND THEIR ACTIVITIES

THE KISAN MOFAT AUSHADHALAYA

(*Free dispensary for the villagers*)

This dispensary was opened in 1926 to supply medicines for the ordinary diseases, and has done a great deal of work in keeping the villagers in good health. There are about 75 medicines for different diseases. In the rainy season the Secretary sends one man every week to put the potassium-permangnate in all the wells. In this way the dispensary spends about 25 lbs. of the potassium-permangnate every

year. The following table shows the service rendered by the dispensary during the year 1936-37—

Name of disease	No. of patients	Cured	Deaths
Cholera ..	69	64	5
Malaria ..	32	28	..
Typhoid ..	4	4	..
Dysentery ..	28	23	..
Other minor diseases and wounds.	99	93	..

From time to time the local Medical Officers and the private doctors visit the dispensary and give some instructions to the Secretary in charge. Their following remarks about the dispensary are worth knowing:—

It seems from the register that 734 patients have been treated free by the Institution up till now. More than 75 per cent. seemed to have got completely cured. The Institution is financed by the Village Panchayat.

(Sd.) A. V. SAHASHRABUDHE, VAIDYA, H.M.B,
Medical Practitioner, Daryapur.

I am extremely glad to see that the Village Panchayat has kept many medicines for ordinary cattle diseases.

(Sd.) L. P. TAMBOLI, G. B. V. C,
Veterinary Surgeon, Daryapur.

It is gratifying to see that such a small village can maintain such a nice dispensary. Number of patients taking advantage of this dispensary is quite satisfactory.

(Sd). M. M. DESHPANDE, M. B. B. S.

To-day, I inoculated 237 men as the epidemic (cholera) is prevailing in the village. Nature of the epidemic is not serious due to the proper medical arrangements made by the

Dispensary. Every kind of preventive measures are also taken by the Panchayat. I am very much satisfied by the services rendered by the Dispensary to the villagers.

(Sd.) K. R DHARMADHIKARI, L. M. & S.,
Chairman, Local Board, Daryapur.

SURANGSHAI KARALAYA

(Ink Manufacturing Society)

This was started by an young and enthusiastic teacher in 1927, to supply good ink at a cheaper rate in the locality. This is a private concern of the teacher. He has earned sufficient money in this business. He undertook this business only as a spare time cottage industry.

KALABATU KALABHAVAN

(Gold and silver threads embroidery works)

This was started in 1928 by an young and industrious man named Mr. Sapkal. He prepared several caps, each worth from Rs. 2 to 12 according to the nature of work. He also sold many shawls, jackets and other articles and earned a lot. The embroidery work of silver and gold threads was worth looking. But unfortunately, the man died in 1933 and the art also went with him. He also had taken up this business only as cottage industry and had made it a complete success.

VASTHU KOTHE SAPADATIL

(A society to get the things lost)

This is a very useful society, and was started in 1932, to collect the lost things and give them back to the owners. Due to our carelessness or even sometimes with eare many of things are lost. Therefore, anybody who finds anything

gives it to the man in charge of the society. The Secretary of the society then gives the thing back to the owner after taking some compensation for his carelessness and gives it as a reward to the man who found the thing.

Anath Durbhiksh Niwarak Sanstha

(*A society to help the poor at the time of a famine*)

This society was started in 1921 to help the poor and needy in famines and at times of the failure of crops. It is financed by the Kisan Stiti Sudharak Sanstha. The society reserves some share of the profits every year for the above society. Fortunately there have been no famine during the last fifteen years, and naturally the reserve fund has by this time accumulated to about Rs 3,000.

Gao Sabha Mandal

(*A general meeting of all the villagers*)

This was established on the 9th October, 1932, on the Dasara festival. This is a festival on which all the villagers gather together with one feeling of unity. In the evening, all of them march to a sacred tree, which they worship and return home. Taking advantage of this gathering the Rao Bahadur decided to discuss and lay-out a programme of village improvement for the next year. From that time, the general meeting is held every year on the Dasara festival in which they pass the resolutions about the work to be done in the next year, and recommend to all the societies for their execution. In short this meeting is the true representative body of the village and therefore, when they decide to do certain improvement unanimously, nobody can object them. Some of the important and interesting resolutions passed by the meeting are given below :—

29th September, 1933.—This meeting resolves to start a co-operative shop, to supply almost all the needs of the villagers at a cheaper rate than a Bania.

17th October, 1934.—(1) This meeting resolves that the contract of supplying water to the cattle must be sanctioned in this meeting only, and not in small private meeting.

(2) Due to the insufficiency and saltish nature of the water, the villagers have to suffer much. This meeting, therefore, recommends to the Village Panchayat to dig a tank in the village.

(3) The temple of God Maruti and the well in front of it need some repairs to make them convenient for the travellers to stay. This meeting, therefore, recommends to the Village Panchayat that it should atonce undertake the work

(4) The people, who stay West of the village are troubled by the insanitary conditions. This is due to the fact that, ladies have no special field or a place for committing motions except the road. This meeting, therefore, recommends to the Village Panchayat to purchase a separate field and make special arrangements for them.

(5) Roads leading to Nachona, Kokarda and Daryapur have been spoiled due to rains. This meeting, therefore, recommends to the Village Panchayat to repair them atonce.

In this way every, several resolutions are passed by this annual meeting and are promptly excuted by the societies concerned.

Vidharbh Gram Panchayat Sangh.—This Sangh was formed in 1928 to spread the Panchayat movement in all the villages in the Province and thereby improve their social, religious, political and economic conditions. The present constitution and the governing body of the Sangh is as follows :—

President.—Diwan Bahadur K. V. Brahma, Advocate.

Vice-President.—1. Mr. Bapurao Deshmukh, Talegaon.
2. Mr. R.A. Kanitkar, Pleader, Buldhana.
3. Rao Sahib R.S. Satarkar, Pleader, Akola.
4. Mr. M. P. Kolhe, Pleader, Yeotmahal.

Secretary.—1. Rao Bahadur U.S. Patil, Itki.

2. Mr. Amrutrao Gokhale, Pleader, Yeotmahal.

3. Rao Sahib Dongare, Retd. E.A.C., Akola.

4. Mr. V. B. Methkar, Pleader, Khamgaon.

This year (1937), the Sangh has Rs. 1,300 in the saving bank and Rs. 450 as an investment in the book-depot, thus giving a total of Rs. 1,750, as capital. Moreover, the Sangh has a Nagri machine (*i.e.* a Marathi typewriter), worth Rs. 350, and four big almirahs (4×7 feet) given by the Rao Bahadur.

The Sangh holds its annual meetings in which representatives of almost all the Panchayats are present. In this meeting, they discuss the policy and work to be done in future for the advancement of the Panchayats. It keeps in touch all the Panchayats with each other, which is the fundamental principle of co-operation.

Vidharbh Gram Panchayat Sangh Book-Depot.—This was opened in 1930, to supply all the registers, books, forms, files, etc. to all the Panchayats in the Province, and thereby maintain the uniformity in records. As the Rao Bahadur is a sincere worker and is also an Honorary Secretary of the Sangh, the Book-Depot was opened in this village and not in any other town. Moreover, this being the best Panchayat, any information regarding its working is supplied from this place.

In the beginning, the Depot had a capital of Rs. 517-2-0, on which it started its activities. During the last seven years, it sold books, registers, files, etc., worth Rs. 3,500 and earned a net profit of about Rs. 2,000.

In this way, the activities of all the above-mentioned societies have created a very good organisation in the village.

THE PUNJAB FRUIT JOURNAL, JULY, 1939.

(Mango Number)

Available from the Punjab P. C. Fruit Development Board, Lyallpur.

Once again the publishers of the Punjab Fruit Journal have won a distinction by bringing out the July 1939, Mango Number, of the journal.

This number, as the title given to it implies, has a major portion devoted to some very important aspects of Mango Culture contributed by notable horticulturists of India who have devoted much attention to the subject in their researches on this particular fruit. The following are some of the outstanding articles in the English Section:—Relation of growth to bearing in Mangoes, Alternate bearings in Mangoes, Propagation of the Mango in the Punjab, Budding of Mangoes, Vitamin contents of mangoes and Limitation of Mango varieties.

In addition to the above there is a comprehensive article devoted to the Preparation of Mango products such as Canning of Mango Squash, Mango Chutney, etc. Important insect pests and diseases prevailing in mango are also dealt with along with their control measures.

The usual General Section of about twenty pages, a distinctive feature of the journal, is also included, consisting of Chronicle of the Fruit World, a large number of extracts and abstracts from leading foreign periodicals, Health Notes, Seasonal Hints, etc.

The Urdu Section has almost the same articles as the English Section translated into simple and, as far as possible, in non-technical language.

The publishers have spared no pains in the printing and get up of this number which is indeed attractive in appearance and immensely useful in reading matter. For the casual purchaser this Number is priced at Annas 10 on the pre-paid Money Order basis or Annas 13 per V. P. P. basis; but for the Annual Subscribers of this quarterly journal (commenceable from this issue) this copy along with the rest will be supplied at Rs. 2 annually on pre-paid M. O. basis or at Rs. 2-6-0 per V. P. P.

THE FARM HOME

Interior Decoration*

BY

MISS M. DOMMISSE,

Home Economics Officer, Grootfontein College of Agriculture, Middelburg, C. P.

Every housewife no doubt desires to live in a comfortable and attractive home. Here she spends most of her time, and uncomfortable and unattractive surroundings will have a detrimental effect not only upon herself, but also on all the members of her family.

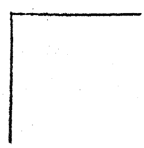


FIG. 1. Opposition.

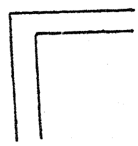


FIG. 2. Repetition.

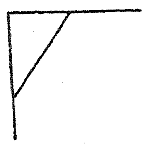


FIG. 3. Contradiction.

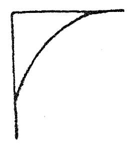


FIG 4. Transition.

There are various requirements for an ideal home, but a house that is perfect in all respects is seldom found. We therefore have to make the best use of our possessions and means, an art which very few people probably understand.

It should be stressed that means do not constitute the most important factor in attaining the ideal. The main requirements are good taste and correct choice, for it is not always the most expensive article that is the best. Whatever we intend making our own, be it an article of dress, an ornament, a piece of furniture, or a house, should always serve its purpose.

*Borrowed from "Farming in South Africa," August, 1939.

A person with good taste will always make the correct choice. Good taste, moreover, may be cultivated by studying and applying the principles of art. In this article it is intended to explain in brief those principles in so far as they apply to interior decoration.

Harmony

Harmony is the sense of unity experienced when different articles, that have something in common, are grouped together or used together, *e. g.* furniture should be in keeping with the type of house.

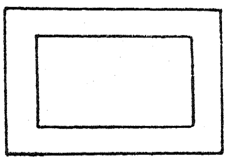


Fig. 5.

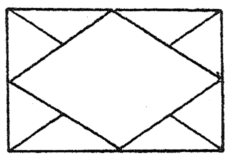


Fig. 6.

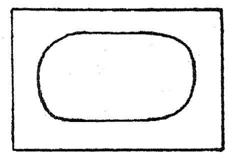


Fig. 7.

Figs. 5-7—Lines combined to form different shapes.

Harmony may be analysed in terms of harmony of line and shade, size, texture, idea and colour.

Line.—Opposing lines are formed when a vertical line meets a horizontal one. Repetition of lines is the simplest way of obtaining harmony. The sharp contrast of opposing lines can be softened by transitional lines only. When they are straight, as in Fig. 3, they form too sudden and sharp a transition, which is not pleasing.

Shape.—Lines which repeat one another create shapes which show perfect harmony (see Fig 5). Place large rugs parallel to the walls of the room. Large pieces of furniture, such as tables, beds, wardrobes and pianos should also be parallel with the lines of the room.

Lines which contradict one another create shapes which form harsh contrasts and are entirely lacking in harmony (see

Fig. 6). When rugs and furniture are arranged so as to form a multitude of corners and angles or lines which contradict one another, the result will always be an unpleasing muddle.

Transitional lines create shapes which form less sharp contrasts and are harmonious. Smaller pieces of furniture may be placed at angles, especially those having rounded shapes, *e. g.* chairs with slightly bent backs, round and oval tables.

Size.—See to it that the size of the pieces of furniture is in keeping with the different rooms in the house. Do not place very large pieces of furniture in a small room. A small table is not suitable for a very large vase, and no attempt should be made to arrange large flowers in a small vase. Never place a small light chair next to a huge heavy one.

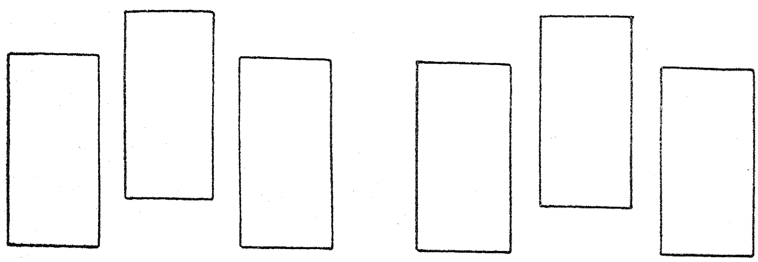


FIG. 8 —Pictures arranged so as to form a whole.

Texture.—Very coarse materials have nothing in common with materials of very fine texture. Brick seems to be related to iron, brass aud coarse pottery, but not to glass. Combine glass and fine lace or materials of fine texture with well-finished woods.

Ideas.—The ornaments in a room, *e. g.* vases, pottery, pictures, curtains, lamp shades, table covers, should harmonize as far as quality of material, colour and texture are concerned. We must not convert our homes into museums by collecting all sorts of curios Somewhere in Johannesburg there is an East African tea room. It is furnished with wicker tables and chairs, while scenes from East Africa are

painted on the walls. All the ornaments are typical of the natives living in those parts. The lampshades are of vellum and made in the form of huts. Round brightly-coloured wicker-work trays decorate the walls, while the floors are covered with mats made by natives. This tea room provides us with an excellent example of harmony of ideas in interior decoration.

Proportion

Proportion is the "Law of Relationships" and deals with size, length, height, and space.

Pleasing proportions contribute much towards making our homes interesting and attractive. The Greeks realized this fact and even to-day we use the Greek standard for obtaining correct relationships. Note the position of the knob on the door; the relation between the height of the seat to that of the chair itself; the size of a mirror as compared with that of the wardrobe; and the proportion between the grate and the fire-place.

When these proportions are good, it will be found that the relation will always be more or less 2 to 3.

The knob of the door measures 3 lengths down and 2 up, or *vice versa*, while the chair has 2 lengths below the seat and 3 above.

In decorating a room this principle will lead us to pay attention to the following:—

1. The furniture we buy must be well-proportioned.
2. The articles of furniture placed in the same room must be of comparable sizes.
3. Spaces, that are all similar, are uninteresting and monotonous.

Care should also be exercised when hanging pictures. These should not be hung without paying attention to size,

shape, interspacing, height above the floor, and the effect of the arrangement as a whole. When pictures form a group, the spaces between them should be smaller than the pictures themselves. When a second group is formed, the space between the groups should also be smaller than that occupied by an individual group. In that case the two groups will form a whole. (See Figures 8 and 9.)

Unpleasing proportions may be altered by making use of a certain kind of lines. Horizontal lines always add to the breadth, while vertical lines heighten the effect of length. Figure 10 appears to be narrower and longer than Figure 11 on account of the vertical lines in the former and the horizontal lines in the latter.

An exceptionally long and narrow room may be made apparently wider by the use of horizontal lines. Curtains should be short with a valance along the top, and where possible the furniture and mats should be arranged parallel with the breadth of the room.

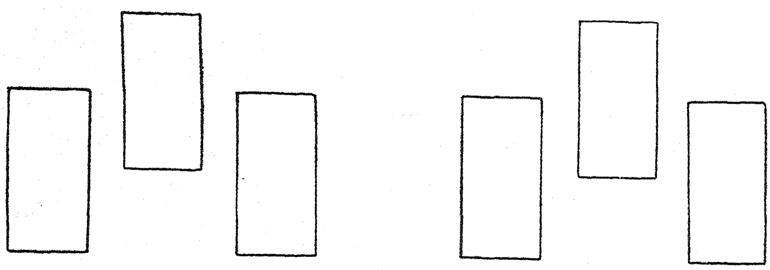


FIG. 9 —Pictures hung too far apart.

Vertical lines apparently add height to the walls. Use long curtains for windows that are too short. When the mirror is too small for the dressing-table, a decorative cover may be hung behind the mirror in order to produce the correct proportion between mirror and table.

BALANCE

Balance is obtained by grouping objects around a centre in such a way that a proportional effect is created.

Equal weights balance when they are at equal distances from the centre. If the weights are unequal, the heavier of the two must be nearer the centre than the lighter one. In art balance is obtained in a similar way. The only difference lies in the fact that we have to decide which object attracts the most attention or is of greatest importance.

In the home there are several centres of attraction, *e.g.* a hearth, a book-shelf, a table, a hall, a cabinet, a couch. Every room should have a centre around which other pieces of furniture and accessories are arranged. Balance must always be preserved. Do not place all the heavy furniture on one side of the room and the lighter pieces on the other.

Emphasis

By emphasis we mean the principle by which the eye is carried first to the most important object in any arrangement and subsequently to other parts. In the home we want to emphasize objects such as beautiful vases, cushions, pictures and articles of furniture.

Various methods are employed, but one of the most important is to keep the background, against which the objects are seen, as plain as possible. The background of a room consists of the floor, walls and ceiling.

Wall-paper with a sharp bright pattern will immediately catch the eye, rendering it impossible to appreciate a picture or lovely vase, which is placed in the fore-ground. Wall-paper, or decorations should not contain patterns that divert the attention. Small patterns grouped closely together are less conspicuous than those spaced far apart. Thus a design, which covers an area well and does not show too much contrast as regards colour and shading, will have a restful effect.

Emphasis may also be effected by having sufficient plain background space around the objects designed to attract attention. It is easier to remember a few objects placed far

apart than a large number placed closely together. Hence never overload a room with furniture, ornaments and pictures. The result will always be a disturbing muddle.

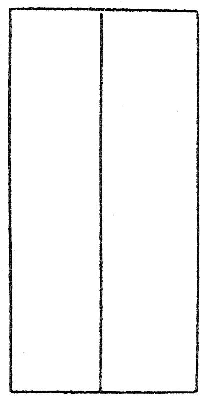
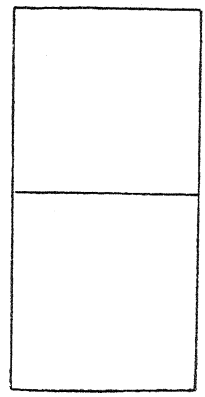


FIG. 10



F G. 11

FIGS. 10-11.—Vertical and horizontal lines alter proportions.

We may also emphasize objects by arranging the furniture in a certain way. The lines of the pieces of furniture and even of pictures always lead the eye in a particular direction. The front door is, for example, emphasized by the path leading up to it. When we turn the ears of two cups towards each other, they will emphasize something. A table is emphasized by arranging chairs around it.

RHYTHM

Rhythm is a form of movement. In a plain space there is no movement. As soon as a pattern is placed in it, however, the eye starts following the design and in this way movement results. This movement may be rhythmic or easy, or it may be restless and unpleasing. All movements are not rhythmic. There must be order in the movement.

We may brighten up our homes by making use of this principle, *i.e.* by introducing movement and life into them.

In art nothing should be overdone, and it may easily happen that there is too much rhythm or that there is movement where there should not be any. We must not arrange pictures so that they lead the eye towards the ceiling, neither must we use wall paper that has a similar effect.

In the case of small surfaces, like cushions, curtains and small rugs, sharp movements are more suitable than in large areas, *e.g.* walls, floors and ceilings.

Furniture should be solid, hence the design of the individual pieces should not result in too much movement. Straight lines create solidity and suggest reflection. Curved lines create movement, and are graceful and free. These are preponderant in Nature. Horizontal lines are quiet and restful : a sense of restfulness is always experienced on sweeping plains.

Vertical lines stretch upward and create a feeling of reverence as in the case of majestic rocks, or a sublime religious feeling as in the case of a Gothic Cathedral. A house with low ceilings is more homely than one with lofty ceilings.

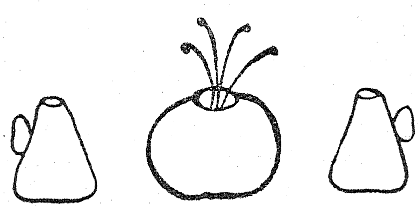


FIG. 12.—Movement directed away from the group.

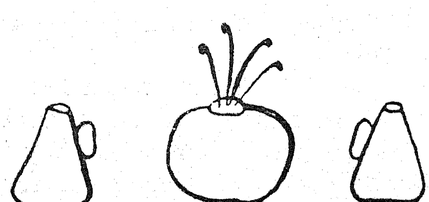


FIG. 13.—Movement kept within the group.

Sloping lines are full of life and movement, and they create a feeling of restlessness and fatigue. A room, in which too much use has been made of sloping lines, cannot have a restful atmosphere.

Rhythm may also be obtained by repetition of lines, shapes or colours. Note the rhythmic movement of steps, of chairs around a table, books on a shelf, pictures on a wall, cushions on a couch, cutlery on a well-laid table, plates

on a shelf, etc. We must see to it that we arrange objects of various sizes as systematically as organ pipes of different lengths or sizes are arranged, so as to form a definite rhythmic pattern.

If we wish to attract attention by means of arrangement, we may make use of rhythm. Movement away from a group destroys the unity of the arrangement, while movement kept within the group converts it into a unit

When a photograph of a group is taken, unity is obtained by the direction in which the individuals face—those on the outside face towards the centre and those in the centre look straight ahead.

We can therefore judge art in the light of the laws of harmony, balance, proportion, emphasis and rhythm The final result of the application of these laws in everyday life will be unity and beauty.

ALUMNI NEWS

The Institute Old Boys' Day came off this year on November 24, 1939. Every year that is a great day in the Institute, when the old and the new meet together and enjoy the occasion.

The day had a busy programme for us. In the morning we had games, then going round the Institute and attending a meeting of the assembly. In the early afternoon the Old Boys had their meeting, then the new were 'at home' to the old, after which all had a fine time in the informal meeting late in the evening.

The Old Boys present that day met together and formed an Interim Old Boys' Organisation of the Allahabad Agricultural Institute. They also appointed an Old Boys' Local Committee, consisting of three local members. The Committee, according to its functions, has sent a circular letter dated December 20, 1939 to the Alumni whose correct addresses are known, giving a report of the Old Boys' meeting in order to get their support and suggestions for forming the full-fledged Old Boys' Association of the Agricultural Institute on the next Old Boys' Day.

THE DIGESTIBLE COEFFICIENTS AND FEEDING VALUE OF DRIED GRAPEFRUIT REFUSE AND DRIED ORANGE REFUSE. *

BY

W. M. NEAL, R. B. BECKER AND P. T. DIX ARNOLD.

Three calves have grown to a live weight of 700 pounds on rations of dried grapefruit refuse and cut alfalfa hay, equal parts, and sufficient cottonseed meal (41% protein) to meet protein requirements. Two Jersey calves have attained weights of over 600 pounds in 14 months on a ration of dried grapefruit refuse and cottonseed meal, 4½ pounds of the former to 1 of the latter, with 20 c. c. of cod liver oil daily. Two other calves received dried grapefruit refuse, sorghum silage and cottonseed meal, without cod liver oil supplement. Good growth and physical condition of these animals were observed. The citrus refuse has a mildly laxative action, and also causes the hair to have a glossy appearance, indicative of good general condition of the animal.

Steers were fattened on dried grapefruit refuse, and on fresh cannery-run refuse, at the Citrus Station, Lake Alfred. These animals gained weight in direct proportion to the intake of total digestible nutrients. No objectionable qualities were imparted to the meat or fat, as verified by palatability tests of these products conducted by workers in the department in co-operation with Miss Beatrice Olson of the Home Economics Department, P. K. Yonge Laboratory School.

Investigation will be made of other means of preserving this by-product as feed during the coming year.

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* Reprinted from Agricultural Experiment Station Annual Report, June 30, 1936, University of Florida. pp. 53-54.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCE

FOR THE MONTH OF OCTOBER, 1939.

I.—Season.—There was practically no rain in the last three weeks in the Meerut, Agra, Rohilkhand and Allahabad Divisions, others receiving light showers. Rainfall in the first week was general. Taken as a whole, it was below the normal with the exception of the two districts, *viz*. Dehra Dun and Sitapur reporting above normal during the month.

II.—Agricultural Operations.—Agricultural Operations are generally up-to-date. Harvesting of *kharif*, picking of cotton, preparation of land for and sowing of *rabi* are in progress.

III.—Standing Crops and IV.—Prospects of the Harvest.—The condition of standing crops is generally satisfactory and prospects favourable. Outturn of cotton crop is estimated between annas ten to annas sixteen of the normal.

V.—Damage to Crops.—No serious damage to crops is reported during the month Red rot in surgarcane was present in the eastern districts, but serious losses were checked by timely action.

VI.—Agricultural Stock.—The condition of agricultural stock is satisfactory. Cattle diseases have declined as is indicated by the following figures furnished by the Director, Veterinary Services, United Provinces :

Diseases	September, 1939		October, 1939	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	3,958	2,410	2,323	1,432
Foot-and-mouth ..	8,063	139	8,181	137
Hæmorrhagic Septicaemia	2,706	2,225	1,055	829

VII.—Pasturage and Fodder.—Fodder and water is available everywhere

VIII.—Trade and Prices.—Prices of the chief food grains *viz.* wheat, barley and gram have risen slightly while that of rice has fallen. The following figures compare the average retail prices in rupees per maund at the end of the month with those of the preceding month :

	End of September, 1939	End of October, 1939
Wheat	3·406	3·486
Barley	2·703	2·806
Gram	3·543	3·558
Rice	4·374	4·259
Arhar dal	4·998	4·998

IX.—Health and Labour in Rural Areas.—The condition of labouring and agricultural classes is satisfactory. Two hundred and fifty-two deaths from cholera are reported from Bahraich District.

For The Month of November, 1939.

I.—Season.—There were no rains during the whole month of November, 1939.

II.—Agricultural Operations. Agricultural operations are generally up-to-date. The harvesting of *kharif* and the picking of cotton is nearing completion. Sowing and irrigation of *rabi* and pressing of sugarcane are in progress.

III.—Standing Crops and IV.—Prospects of the Harvest.—The condition of standing crops is satisfactory and prospects are favourable. A statement showing the outturn of various *kharif* crops as reported by the District Officers is appended.

V.—Damage to Crops.—No serious damage to crops is reported.

VI.—Agricultural Stock.—The condition of agricultural stock is satisfactory, though cattle diseases still exist in most districts, but there has been appreciable decrease as compared with the previous month, as will be seen from the figures furnished by the Director, Veterinary Services, United Provinces:

Di-eases	October, 1939		November, 1939	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	2,323	1,432	1,094	651
Foot-and-mouth	8,181	137	3,621	15
Hæmorrhagic Septicaemia	1,055	829	167	140

VII.—Pasturage and Fodder.—Fodder and water are sufficient everywhere.

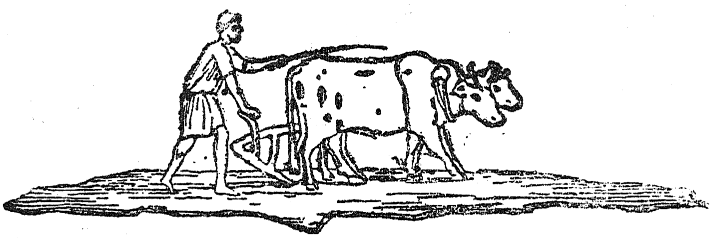
VIII.—Trade and Prices.—Prices of all chief food grains have arisen appreciably. The following figures compare the average retail prices in rupees per maund at the end of the month with those of the preceding month:

	End of October, 1939	End of November, 1939
Wheat	3·486	3·964
Barley	2·806	3·066
Gram	3·558	3·859
Rice	4·259	4·484
Arhar dal	4·998	5·131

IX.—Health and Labour in Rural Areas.—Public health continues satisfactory. Plague, cholera or smallpox still exist in some districts. The condition of labouring and agricultural population is satisfactory.

THE

ALLAHABAD FARMER



VOL. XIV] FEBRUARY, 1940 [No. 2.

An Editorial.

"Indian Farming"

This is the title of a new journal that is being put out by the Imperial Council of Agricultural Research. The journal is supposed to take the place of another journal, The Agriculture and Live-Stock in India, which has now ceased to exist.

We very much welcome this new move of the Imperial Government, as we believe this shows a shifting of emphasis from the pure research and experimentation to extension and the reaching out to the Indian farmers. Research and experimentation however will not be neglected as we shall still have the results of such researches and experimentation in another sister journal entitled the Indian Journal of Agricultural Science, and published by the same body.

Speaking from our limited experience, we believe this new journal, coming as it does from the Central Government, will have the widest circulation in this country, if it caters to the needs of the cultivators of the soil. The Indian farmer has many problems to solve, and if "Indian Farming"

would offer solutions to the problems, his needs would be greatly met.

We therefore wish the new journal a very useful life and hope that through its efforts greater prosperity will be brought about in the land.

The Late Sir Daniel Hamilton.

Sir Daniel Hamilton passed away at his home in Scotland, on the 6th December, 1939 Sir Daniel was one of the most ardent advocates of the co-operative movement; in fact, he was intimately associated with the work of co-operative societies in this country from the very beginning, and worked actively to further the cause of co-operation up to the close of his life. He was a member of the Committee on Co-operation of the Imperial Legislative Council of India, whose deliberations led to the passing of the first legislative measure on co-operation in India, namely, the Indian Co-operative Credit Societies Act of 1904. As a businessman Sir Daniel rose to be the senior partner of Messrs Mackinnon, Mackenzie & Co., the well-known shipping firm, and became President of the Bengal Chamber of Commerce. Though he retired from business about a generation ago, advancing age did not in any way abate his interest or diminish his enthusiasm for the causes he upheld. In the Memorandum that he submitted to the Joint Parliamentary Committee on the White Paper on Indian Constitutional Reforms he asked, "Will the Constitution outlined in the White Paper make for unity?" To this he supplied the following answer: "I think not; it will divide India still more It will set party against party, class against class, master against servant, man against man." During his last visit to India in the course of a speech in February, 1939, he said:

"If co-operation is the best hope of rural India, so is it also the best hope of industrial India; for co-operative finance can be applied to manufactures as well as to agriculture; and the workers in the mill can become the owners of the mill, and Capital and Labour become one. Strikes then go, peace comes, and a new spirit turns the wheels of industry; and I am

persuaded that it is along these lines that the jute growing and manufacturing problems of Bengal will ultimately be solved. To help in their solution I would suggest that a small experimental mill on these lines be erected, one third of the capital being found by the existing jute mills jointly, and two-thirds by the mill-workers and jute growers respectively. Government (through the Reserve Bank) finding the workers' and growers' capital, recovering the loans from the profits over a period of years."

Sir Daniel left no stone unturned to effect an all-round improvement of moral, educational, and economic condition of the tenants of his Estate at Gosabba and it can truly be said that the Estate existed for the tenants and not the tenants for the Estate.

By the death of Sir Daniel Hamilton, the Allahabad Agricultural Institute, and India in general, loses one of her truest friends.

K. F. A.

Old Copies of the Allahabad Farmer

The following copies of the Allahabad Farmer are needed. If any of our readers or subscribers wish to re-sell them, they will be purchased at As. 12 per copy.

1925 Vol. I, Nos. 1, 2 and 3.
1926 No. 4.
1927 Nos. 2, 3 and 4.
1928 All copies.
1929 Vol. III Nos. 1, 3 and 4.
1930 Vol. IV Nos. 2 and 3.
1931 Vol. V Nos. 1, 3, 4.
1933 Vol. VII No. 1.
1934 Vol. VIII Nos. 1 and 4.

THE EDITOR,
The Allahabad Farmer,
Agricultural Institute,
Allahabad, U. P.

THE BORE-HOLE LATRINE—WHAT, WHY, AND HOW?

By Mason Vaugh, B. Sc. Ag., A. E.,

The Agricultural Institute, Allahabad

The bore-hole latrine has interested many people who wish to find more sanitary methods of sewage disposal and methods which do not require the services of a sweeper. Its cheapness, combined with the present interest in the removal of untouchability has perhaps attracted to it more attention than any other method of sanitary sewage disposal has received.

The first essential in discussing any new thing is to know what we are talking about. What is a bore-hole latrine? A bore-hole latrine is a latrine the essential feature of which is a round hole 10 to 20 inches in diameter and from 10 to 25 feet deep, bored into soil (not into rock) and covered by a suitable squatting plate or seat. A rectangular or square hole, conforming to approximately the same dimensions, would be practically identical in action but in most cases harder to make and to clean out when necessary. Any sort of screen—mud wall, brick wall, reinforced concrete, galvanised iron, wood, bamboo, mat covered with mud plaster, matting, vines growing on a simple framework—can be used to secure privacy.

A definition is often made more definite by saying what it is not. A bore-hole latrine is not a cesspool as used in western countries. It is not a *deshi sandas*, or a pit latrine. The *sandas* is more closely related to the old fashioned cesspool. It is not a pit latrine as the term is usually used. The pit latrine consists of a large but shallower pit into which flies go freely and in which they breed freely.

What is it good for? The bore-hole latrine is essentially a device for providing sanitary sewerage for individual

families at a low price and without requiring the services of a sweeper. In general, any one bore-hole should not have more than an average of five to seven users. Occasional and short-time overloads are all right, but for best results, the steady load should be about five users. I do not consider it suitable for schools, boarding houses, hospitals or other institutions where large numbers are to be cared for in a small space. It is definitely and only a device suited to the use of small or ordinary families, particularly in villages and open towns In my opinion its regular use for other purposes should be discouraged. For temporary use at camps, fairs and special occasions, lasting only a few days, it may be used for larger numbers of people.

It is unnecessary to spend time on discussion of the need for sanitary methods of disposing of night-soil. The danger of spreading disease when fæcal matter is exposed to flies is well known. The social obligation to relieve the sweeper of his task has had much publicity recently. The ordinary bucket latrine offends in both of these particulars, besides being offensive in sight and smell. The commode as used in better-class homes is little, if any, better when the night soil is disposed of as it often is. While going to the fields may be reasonably satisfactory under ideal conditions, these ideal conditions are rarely attained in practice and much intestinal disease in India can be traced to this practice. The comfort and convenience of the women folk especially, would be greatly improved by the use of a suitable latrine. Not infrequently, quarrels and bad feeling result from the necessity of women leaving their homes to go to the fields or to public latrines.

For village and small-town homes, the bore-hole latrine meets all the requirements of sanitation, comfort and convenience. It is sanitary, free from objectionable sight or smell and does not require cleaning or care as a daily routine. In addition to this, it conserves, in a very large measure, the manurial value of the human excrement in a safe and inoffensive way.

The manner of making the bore-hole latrine is simple Usually the bore-hole is made by the use of a large soil

auger such as is used for setting posts and telegraph poles. Sevaral types are in use. Sizes of less than 10 to 12 inches fill up so fast that they are not very practical. Above 18 inches in diameter the borer or soil auger becomes so heavy and unwieldy that it is very difficult to manage. About 18 inches in diameter seems to be the ideal size, combining maximum capacity with usability of the boring tools. Suitable borers cost from thirty to one hundred rupees each.

Most borers work by simply turning them in the soil till filled. When the borer is filled, it is lifted out of the hole and emptied. Some recommend the use of a tripod and rope over a pulley for lifting the borer out. Others dispense with this and merely lift the borer out by hand. The borer should be provided with suitable extension handles, preferably in pieces, multiples of about 2 feet 6 inches to 3 feet so that the handle can be extended at that interval. Shorter multiples of the handle extension permit the borer to be turned by a fixed handle while longer sections require the use of a separate removable handle which must be disconnected when the borer is taken out for emptying. When hard clay or *kankar* is encountered, it is necessary to loosen this material by using a heavy bar or chisel point fixed on the end a bamboo, wooden bar or pipe. Where most of the soil is difficult to dig, loosening the soil with a bar and removing it with a special spoon or shovel may be desirable. Where the soil is soft and easily dug, the borer is to be preferred.

The bore-hole must be covered by a suitable seat or squatting plate. Where large numbers are to be made and used in a restricted area, reinforced concrete is a suitable material. Where only a few are needed, the cost of suitable forms and the delay involved in waiting for each to set when only one form is used is a disadvantage. Very satisfactory seats have been made by cementing brick together with one to three cement-sand mortar. No form is required. A suitable place on the ground is smoothed off, 2 feet 6 inches square, and sloped so the centre is 1½ inches lower than the edges. First class or overburned bricks are arranged on the

space, leaving a hole of suitable size and shape in the centre. Two iron rods, one-quarter inch in diameter, are put into suitable joints in each direction and the joints between the bricks filled with cement mortar. Care should be taken to get a thin layer of cement underneath each of the iron rods, but the rods should be near the bottom of the joint. After filling the cracks or joints, the whole surface should be plastered with a cement mortar. The one to three mortar is suitable, but a small amount of neat cement slurry may be used to polish the surface. Dry cement should never be used in any circumstances. Treating the surface with sodium silicate (water glass) will tend to densify and harden the surface, reducing the absorption of odours somewhat. In the absence of sodium silicate, tar may be used. Tarring the underside as well as the top is recommended. Such seats can be made at an inclusive cost of about Rs. 1-8-0, in most sections of the plains. Concrete ones cost from one rupee eight annas to three rupees eight annas in different localities. For those accustomed to and preferring a commode on which to sit, the ordinary commode with a sheet metal tube substituted for the ordinary commode pan can be used.

As indicated before, any sort of screen can be used round the latrine to afford privacy. It is desirable, but not entirely necessary, that it should be portable. Rigidly fixed *pakka* roofs should be avoided as they interfere with subsequent cleaning. It is generally recommended that the screen should be exactly the size and shape of the squatting plate to discourage fouling. Ventilation round the bottom and top where a roof is provided is desirable.

In use, the fæcal matter is deposited directly into the bore-hole without the necessity of using water. The addition of water is optional. The presence of water in the bore-hole will increase the liquefaction of the organic matter and so prolong the life of the latrine Manure will be conserved by having the latrine comparatively dry. The two objects will have to be balanced against each other.

A latrine fifteen inches in diameter and twenty feet or more in depth will last an average family for about a year,

when no special effort is made to prolong life. When it fills to within five feet of the surface, some smell may be evident and the pit can be considered filled. Another bore-hole should be prepared nearby, space for it having been reserved when the first one was located. The squatting plate and, if portable, the screen may be transferred from the first to the second. The first is left till the second is full, when the first can be cleaned out with the same tools and method as used in making a new bore-hole. The manure recovered is valuable, in some places in South India as much as ten rupees' worth per bore-hole being reported. The material removed, if it has been left as much as three to four months after being used last, is fully decomposed into a fine manure, innocuous bacteriologically and with the appearance and lack of smell of well-rotted stable manure. It is not offensive to either sight or smell. Two bore-holes can in this way be used indefinitely.

The ownership of the borer and the making of the holes is a matter for a contractor or a co-operative society. One borer can care for some two hundered or more families, when once the system is in operation and the holes can be made or cleared in rotation. It would be a profitable business if the contractor accepted the manure recovered for his services. Alternatively, a cash payment may be made and the manure reserved for use on the family fields. If owned by the co-operative society, labour can be provided by the men of the family and the machine taken on hire. It is not necessary for individual families to own borers.

The cost is always important in introducing any new device. The bore-hole latrine is probably the cheapest possible method of providing for sanitary disposal of night-soil. Under very favourable conditions, a bore can be put down for about three rupees, including the squatting plate, but not the screen. Under very unfavourable soil conditions, the cost may be as much as seven to eight rupees per bore. After the first year, there should be a profit from the value of the manure, over and above any cost.

Now for questions invariably asked. Does it smell? It is practically or completely odourless so far as the latrine is

concerned. Unless tremendously overloaded, there should be no smell at all at any time. When nearly full, there may be a little. If the latrine is to be used till full, the use of a little dry dirt, or ashes from the cooking fires, or lime, will reduce the smell or eliminate it entirely, prolonging the boro-hole's life, especially in areas where the ground does not permit deep holes. The odour could hardly be worse than that from the ordinary bucket latrine, which it will usually replace. Some of the places where people go to the fields, but visit rather small areas, are not particularly savoury. Thorough tarring top and bottom will also help to prevent smell as will correct use.

Do flies breed in it or visit it? The ordinary house fly does neither. If carelessly used and fouled, of course it will be visited. Flies will not breed unless it is filled practically to ground level. Some cases of blue-bottles' breeding in them have been reported at certain seasons. In two cases, the putting of ashes into the bore-hole from the kitchen fires stopped this completely and at once. The pouring in of a couple of buckets of water daily is also reported to stop the trouble. Lime in small quantities is also recommended, especially when the hole is nearly full.

Finally the major question—Does the bore-hole latrine pollute the underground water supply? There is a variety of opinion expressed and often considerable heat generated over this question. I have seen no scientific data secured under controlled conditions to prove whether it does or not. Dr. D. S. Hatch says that pollution does not occur 'according to experiments' when the bore-holes is twenty-five feet from a well. Second bore-holes put down within four feet of old ones show no sign of smell or other evidence of contamination. The United Provinces Public Health Department officials, in private conversation, have given fifty feet as a safe distance. There is urgent need for someone with facilities for bacteriological work, and located in an area where the underground water level is near the surface, to make a study of this by putting a series of bore-holes near a well and testing for contamination.

On purely theoretical considerations, backed by such knowledge as we have, there seems no reason to fear such contamination. Certainly it can be ruled out where the water level is fifteen feet or more below the bottom of the bore-hole. The Rockefeller Foundation workers recommend putting the bore-hole right into the ground water where possible, with no warning as to contamination. The fear of contamination is based on the idea that there is an underground flow of water. Where there is a source of water, such as an old-fashioned cesspool fed by water flushed closets, or a septic tank discharging a considerable amount of effluent into a so-called soakage pit, or a surface drain carrying considerable water, there is of course the possibility of such contamination. In the bore-hole latrine, there is not enough liquid to carry the contamination far unless the bore goes into the ground water. Bacteria of pathogenic varieties are non-motile in soil and can only be transferred when water borne. Even where there is considerable flow, the soil exerts considerable filtering action. Bacteriophage may enter into the question.

The existence of underground water flow, commonly assumed even by many engineers in India, is not proven scientifically. If there is any flow it is very slow indeed and can hardly be called a flow but rather a very slow drift. In valleys between hills where the depth of soil is small and the alluvial fill is coarse, there is of course a considerable flow, greater with a greater slope of the valley floor. In the plains area, the situation is different. There, the situation is much more that of a lake filled with sand. The fact that water flows into a well when it is being dug and often rises some distance is due to geological conditions and does not prove an underground flow.

While wells are very commonly contaminated in India, there is no evidence that the contamination is in the underground water. If it were, the use of permanganate or chlorine to clear up infected wells would be useless. There is every reason to believe that contamination is wholly, or nearly wholly, through the open top of the well, and that

provided the well is covered and water drawn by a pump and there is reasonably good drainage around the well, there is very little chance of contamination. The common system by which the women go to the fields, often to a small area where the ground is heavily polluted, and then go to the well and draw water with a rope which is thrown on the ground and on which the woman stands to keep it from running back into the well, is much more likely to lead to contamination than is a bore-hole latrine near the well. I have seen no scientific evidence that there is any real danger of contamination from bore-hole latrine.

To summarise. The bore-hole latrine is a deep hole of small diameter into which fæcal matter can be deposited conveniently for sanitary disposal. It must be made by a special boring tool. It is not a pit latrine; it is not a cesspool; it is not a *deshi sandas*. It is a cheap sanitary method of providing for the disposal of family sewage without requiring the services of a sweeper. It provides for the conservation of the manure value of the human fæces. It is not offensive to sight or smell. Flies do not visit or breed in it. So far as available scientific evidence shows, there is no danger of polluting underground water supplies.

Over 30,000,000 gallons of ice-cream are consumed in Britain every year.

Turkeys and guinea fowls were first brought to England about 1523. Turkeys are natives of America. They were consequently unknown to the ancients.

Lettuce was introduced into England from Flanders about 1520 It is said that when Queen Catherine wished for a salad she had to send to Holland or Flanders for lettuce.

GENERAL PROCESS OF MAKING JELLY.*

By

A. DAYAL CHAND, M.A., B.Sc. (AGRI.) F. B. H. S. (LONDON).

The underlying principles have received full attention in the preceding chapter. It is necessary however to give a broad outline of the process so as to indicate precisely how these principles can best be applied. The purpose of the outline is to enable any amateur to get good result if he follows it step by step. Careless manipulation may discourage even skilled hands.

The process involves the following steps which should be taken in this order:

1. Selection of fruits.
2. Preparation of fruits.
3. Extraction of juice.
   - (*a*) The kind of kettle required.
   - (*b*) The amount of water required.
   - (*c*) The length of cooking.
4. Straining and filtration of juice.
5. Testing the acid and pectin content of juice.
6. Sugar requirement.
7. Length of boiling period.
8. Skimming and clearing.
9. Testing the jelling point.
10. Filling and sealing the containers.
11. Labeling.
12. Storing.

Selection of fruits: - Our primary requirements for making jelly are acid, pectin and sugar. The two former

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*Continued from previous issues

are the limiting factors. Only those fruits which contain sufficient acid and pectin to yield good jelly without the addition of these ingredients, are suitable. Fruits are at their maximum in pectose and pectin content when they have attained their full size and are just reaching maturity. It is at this stage that the fruits should be selected for making jelly. It must be remembered that over-ripe mouldy and practically rotten fruits bring about hydrolysis in pectin and deterioration in colour and flavour. Although the pectin can be replaced, the colour may be restored by the addition of edible colours, as is done in many countries; the loss of the original aroma of the fruits can never be made good.

It is not impossible to make jelly from young or over-ripe fruits, but jellies made from the former turn out to be cloudy, lacking in both natural flavour and colour. The jellies made from the latter are sticky, gummy and highly undesirable. It is therefore necessary that for commercial purposes especially when the jellies are to be exported or kept for a long period neither green fruits nor over-ripe fruits be used. In order to prepare jellies more economically the manufacturer should always be on the lookout to secure a good supply of sound fruits wherever they are cheaply and abundantly available. The fruits are not always available, due to the fact that the season for many particular fruits is very short and the manufacturers have to stop their plants for the rest of the year. This is the most difficult problem with which the fruit preserver has to cope; especially in countries like India. It would be of an enormous value if any method of preserving fruits to prolong the maufacturing period be worked out. The measures that would be possible for Indian climates are the cold storage, refrigeration and the addition of preservatives. Bombay Presidency has taken the lead in setting up cold storage experiments which have shown wonderful results. But there is still scope to find out which method would be more economical and more suitable for Indian conditions.

Preparation of fruit:—The method of preparing fruit has not been given due importance by many writers, yet it

is very important because the clearness and the attractive colour of the jelly depends upon it Almost all fruits require some sort of treatment before they enter the boiling pan. The fruits should be carefully sorted, that is keeping only suitable ones and discarding the rest. The soft berry fruits such as the grape, raspberry, gooseberry, etc., are not only sorted but leaves, stalks, and blossom ends removed; and washed and some times crushed before boiling, because most of them are cooked without additional water. The hard fruits such as apples, pears, guavas and quinces and the citrus fruits should be cut in pieces 1/8 to 1/4 inch in thickness, so as to get rapid and uniform softening of the cellulose, to allow the liberation of pectin, and to convert the pectose (insoluble to pectin (soluble) on which the proper setting of jelly depends.

The peeling and coring of fruits is unnecessary and uneconomical, since these parts are rich in pectin.

Stone fruits such as mangoes, peaches and plums should be freed from stones before cooking, and cut in pieces in order to allow rapid and uniform cooking. The presence of stones however does not impart any undesirable character to jellies. Fruits like the wood-apple should be broken and only the pulp cooked.

Extraction of juice:—(*a*) The kind of kettle required.

The composition and the shape of kettles are two very important factors which must never be neglected.

There are several fruits and vegetables such as sour apples, sour grapes, currants, mangces and tomatoes, which are rich in acid and the tendency of acid is to react with certain metals and corrode them. The strength of the reaction varies with the strength of the acid in the juice and the kind of metal with which it comes in contact, but there are certain metals which are not acted upon by weak acids. Certain chemical compounds so formed are deadly poisonous, some are harmful, but the others become injurious only when accummulated in the system. It is a matter of great importance and responsibility that the manufacturer should be quite conscientious in selecting the kettles for cooking fruits and boiling juices.

Fruits cooked in cooper kettles not only become injurious but also lose lustre and flavour. Tin decolourizes the red juices and the red pigment in acid solution combined with tin forms a violet coloured salt which is injurious. Aluminium is the best available metal which does not change the colour of the fruits. It also conducts the heat more rapidly to the top of the kettle than do other metals so that the contents are cooked more uniformly and are less apt to scorch. Agate, steam jacketed, glass lined kettles are the best kinds of kettles which can be used for both acid and non-acid fruits without the least deterioration The only drawback of such kettles is that they are slow conductors of heat due to the thickness of their walls.

As regards the shapes of kettles for boiling juices the shallow ones should be preferred to deep kettles because the juice is heated quickly and is concentrated rapidly, which is a very important factor in obtaining brilliant coloured jelly.

(*b*) The amount of water required:

The addition of an adequate amount of water varies with the hardness or softness of the furits and their acid and pectin contents. It is very difficult to lay down a hard and fast rule for the exact amount of water to be used for the extraction of juice from various fruits. It all depends on the stage at which the fruits are used and their pectin content. More water is required if the fruits are hard or rich in pectin and less if the fruits are soft or poor in acid and pectin.

As a general rule the amount of water should be so adjusted as to get the maximum juice containing enough pectin to make the juice jell when boiled with sugar. According to Cruess "Juicy fruits require no water; apples from one and a half to an equal amount of water, and citrus fruits, because of long period of boiling necessary, usually require from one to two volumes of water for each volume of sliced or crushed fruits." This much information is inadequate for practical purposes. The author has found that other conditions being the same, if the fruits are selected at the right stage, the following amount of water with various fruits yield the maximum juice of desirable pectin concentration.

Table IV.

The amount of water and the length of cooking required for various fruits.

Name of fruits.	Amount of water in pounds per lb. of prepared fruit.	Length of cooking in minutes.
Apples	1½—2	20-30
Apricots	2	20-30
Aonla	4	40-60
Banana	3	15-20
Blackberries	Nil	5-10
Currants	¼-½	5-10
Cape-gooseberries ...	½	5-10
Crab-apple	1½—2	20-30
Cherries	Nil	5-10
Elderberries	Nil	5-10
Grapes	¼	5-10
Grapefruit	3	30-45
Guava	4	30-40
Gooseberries	Nil	5-10
Jujube	2	20-30
Jamun	3	15-20
Karonda	3	15-20
Khatta or Karna ...	4	30-45
Kaitha	3	20-30
Kumquat	3	30-45
Lemon	4	30-45
Lichies	2	10-15
Loquats	2-2½	
Mangoes	3	20-30
Oranges	3	30-45
Peaches	2	20-30
Pine-apples	2	15-20
Pummelo	3	30-45
Plums	3	20-30
Papaya	2	15-20
Quince	3	45-60
Roselle fresh	2	10-15
Roselle dried	10	15-20
Raspberries	Nil	5-10
Strawberries	Nil	5-10
Tomatoes	Nil	10-15
Wonderberries	Nil	5-10

The length of cooking.—The object of cooking fruits is to extract pectin, acid, sugar, salts, vitamins, colouring matter and flavour from the fruits With the exception of the first the rest are easily extracted, because they go into solution readily even at low temperatures. It is the pectin which cannot be extracted unless the hard fruits are sufficiently softened. Long cooking allows the volatile flavour to escape, renders the juice cloudy, causes the extraction of astringent substances and converts some of the pectin to pectic acid The length of cooking is therefore a very important step which should be judiciously manipulated. The fruits should be cooked for as limited a period as possible to soften the fruit tissues to such a point as to get the maximum juice with a desirable pectin content. It is found that the shorter the period of cooking the better the flavour and texture of the finished product. The periods of cooking of various fruits given in the table No. IV have been found most desirable.

Straining of Juice.—The purpose of straining is to get as clear a juice as possible. Success in achieving this object depends upon the right type of jelly bag and the method adopted. If the juice is squeezed by force through a thin cloth jelly bag, no doubt the last drops will increase the acid and pectin concentration of the juice; but it will also render the juice so cloudy as to make the filtration impossible and also to make the final product unsightly. In order to overcome this difficulty a thick cloth bag, preferably made of felt or thick flannel should be used, and the juice should be allowed to drip itself without pressing. If it is desired to extract as much acid and pectin from the fruit as possible, several subsequent extractions may be made with a little water each time and the total amount of extraction be concentrated to a desirable amount.

Filtration.—Filtration of juice is necessary in order to get brilliantly clear jelly Some juices such as *kaitha* (wood-apple) and *karonda* are naturally cloudy and cannot be rendered absolutely clear, but by filtration their clearness can be improved. In large factories pulp filter presses are used to

hasten filtration and to get fairly clear juice with a second or third filtering. But for small factories heavy felt or flannel jelly begs have been found quite satisfactory.

For the further clarification of juice, the use of various electrolytes such as powdered alum, milk or fuller's earth may be used while the juice is boiling and before the addition of sugar. The sugar increases the viscosity and makes straining slow or impossible. The easiest method of clearing the juice is to allow it to stand in a shallow pan for 24 hours and siphon it, leaving the sediment at the bottom

The most recent and scientific method now in vogue for clearing juices is centrifuging, which is quicker and more satisfactory.

Testing the acid and pectin content of juice.—The approximate acid content of the juices can be readily determined by taste, but the amount and the quality of the pectin content of every juice should also be determined. The methods of determination of acid and pectin are discussed at full length in a previous article. If the juice is efficient in either of these ingredients, steps should be taken to correct it at this stage before boiling with sugar. If artificial acid and powdered pectin are available, well and good; otherwise fruit juices rich in acid and pectin may be blended according to the requirement.

The success of making jelly depends on the careful manipulation of this step. If it is missed or overlooked the chances are that either the jelly will not set or it will be poor in texture.

Addition of Sugar—There can be no rule of thumb suggested for the amount of sugar required, because it is apt to vary with the following factors:

(*a*) Sugar content of fruits.

(*b*) Acid and pectin content of fruit juices.

(*c*) Amount of water used for cooking fruits.

(*d*) Length of cooking fruits.

(*e*) Period for which the juice is kept after it is cooked and strained.

A good jelly can only be obtained if the sugar, acid and pectin bear a certain definite relationship to one another.

The sugar content of most of the fruits ranges between 2 and 11 per cent, sucrose and reducing sugars such as fructose and glucose being present. If the additional amount of sugar is added irrespective of the sugar content of the fruits, it is sufficient to throw the relative proportion of the essential ingredients out of balance, which is apt to cause serious damage to the final product.

The acid and pectin in the juice also has a great bearing on the sugar requirement.

A large amount of water used for prolonged cooking of fruits reduces the acid and pectin content of the juice; whereas too small an amount raises the acid and pectin concentration. Neither condition is ideal. So the amount of sugar required varies. As a general rule, the higher the acid and pectin content of the juice, the greater the proportion of sugar is used.

It has also been found that if the juice is kept for a long time after extraction, especially in hot weather, the essential ingredients hydrolyse to a certain extent leaving the juice deficient in these ingredients. The manufacturer should keep all these factors in mind before deciding the sugar requirement of any juice. There is a general tendency toward adding sugar by volume, but in order to be more accurate the sugar should be measured by weight rather than volume.

The proportions of sugar given in the table No. V have been found adequate for getting the maximum yield of good texture jellies.

Ogg observed that the concentration of sucrose which gave the maximum strength of gel in a mixture containing 0.125 per cent of pectin and 1·5 per cent of N/10 acid was

found to be 67·5 per cent but it may vary between 68 to 72 per cent. The adequate proportion of sugar which gives maximum yield at the range of temperature noted is given below:

Name of fruits.	Amount of juice in lbs.	Amount of sugar in lbs. by wt.	End Point in Fc.	Yield in pounds of jelly by volume.
Apples ...	3	3	221-222	2½-3
Apricots ...	3	2½	219-221	2½
Aonla ...	3	2½	219-220	2¼-2½
Banana ...	3	2½	220-222	2¼-2½
Blackberries ...	3	2¼	220-222	2¼-2½
Currants ...	3	3	218-220	3-3½
Cape-gooseberries...	3	2	220-222	2¼-2½
Crab-apple ...	3	3	221-222	2½-3
Cherries ...	3	2½-3	220-222	2½-3
Grapes ...	3	2½-3	220-223	2½-3
Grapefruit ...	3	3-3¼	219-221	3-3½
Guava ...	3	2¼-2½	222-224	2½
Gooseberries ...	3	2½	220-224	2¼-2½
Jujube ...	3	2½	220-222	2½
Jamun ...	3	2½	219-221	2½
Karonda ...	3	3	218-220	3-3½
Khatta or Karna...	3	3-3½	218-220	3-3½
Kaitha ...	3	3-3½	219-221	3-3½
Kumquat ...	3	3	219-221	3-3½
Lemon ...	3	3-3½	218-220	3-3½
Lichies ...	3	2-2½	220-222	2¼-2½
Loquats ...	3	2-2½	220-222	2 -2½
Mangoes ...	3	2½-3	221-223	2½-3

Time and method of adding sugar.—If the sugar is added to the cold juice rich in acid and pectin, small lumps are formed at the bottom. Spencer describes this condition, saying, "that each sugar crystal forms a nucleus of gell formation, that the separate masses of jelly so formed persist during subsequent boiling. "So in order to prevent preliminary precipitation of pectin, the sugar should gradually be added as soon as the juice begins to boil, stirring it slowly and continuously. If the juice is thin it should be concentrated

before the addition of sugar, because the presence of sugar during boiling decreases the jelly strength" Hayes recommends that "sugar may be heated before it is added, to hasten the cooking process, but this is not essential."

Length of boiling.—The length of boiling is the key on which success depends. The main objects of boiling are:

(*a*) To dissolve sugar.

(*b*) To bring sugar, acid and pectin into a harmonious union to form jelly.

(*c*) To concentrate sugar to the point where jelling will occur.

(*d*) To coagulate certain organic matters which rise to the surface in a mass and can be skimmed off.

The boiling operation should be rapid, uniform and for as short a period as possible to get a bright and clear product. Long slow cooking after the addition of sugar causes the following defects:

(*a*) It impairs the flavour of the product.

(*b*) It tends to darken the colour.

(*c*) It reduces the yield.

(*d*) It dehydrolyses the pectin into pectic acid and methyl alcohol.

(*e*) It weakens the jelly strength.

(*f*) Prolonged boiling brings about inversion of sucrose (cane sugar) to fructose (levulose) and glucose (dextrose).

$$C_{12}H_{22}O_{11} + H_2O = C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose + Water = Fructose + Glucose.

This is a frequent cause of total failure in manufacturing jelly.

In order to guard against these defects steps should be taken to reduce the boiling period to the minimum and the following precautions should be taken to that end.

(1) Make jellies in small quantities at a time.

(2) Use flat-bottomed, shallow kettles with volumes four to five times greater than the amount of juice, to allow rapid boiling and quicker evaporation.

(3) at the time of extracting juice use just enough water to obtain the maximum amount of juice rich in acid pectin.

(4) Make the pectin test and adjust the acid and pectin concentration.

Skimming and clearing.—No matter how properly the fruit juices are filtered, there always exist organic matter, which is precipitated by heat and forms a layer on the surface of the juice. This layer should be completely skimmed off before the juice starts boiling, for otherwise the layer breaks up and cannot be wholly removed. At this time skimming will not be wasteful because the sugar is not yet added Sugar too, always contains certain impurities. On the addition of sugar the juice becomes cold again and before it reboils, a layer of organic matter rises to the surface, which should be skimmed off.

If the juice, to start with, was cloudy, it may be cleaned by further precipitating organic matter by the addition of electrolyses such as alum solution (calcium chloride) or milk, while the juice is boiling. For purer fruit juices skimming may even be delayed till the jelly is cooked and removed from the fire.

Determination of end point.—The determination of the *end point* is the most delicate task in the jelly-making process. The *end point* may be defined as the desired consistency of the final product described in the definition of jelly in the beginning of a previous article. It depends upon bringing about a certain range of ratios between acid and pectin and sugar by controlling the length of boiling period. We have already observed the defects caused by prolonged boiling. Then the question rises; when should the boiling cease? The answer to this question may be that the *end point* may vary with the definitions preconceived by the maker of jelly. A housewife may regard a soft jelly as an

excellent jelly and a manufacturer selling his products locally may be thinking in terms of slightly stiffer jelly; while the manufacturer who ships his jellies to other countries would certainly make much stiffer jellies than mentioned above, so that it may stand rough handling. The *end point* may therefore be governed by the purpose for which the jelly is made. A few methods of testing *end point* are given below :—

1. Sheeting test —Take a few drops of juice by dipping a large spoon into the kettle, cool it and allow it to run down from the side of the spoon. If the drops flow together, congeal and hang from the side of the spoon in a sheet, the jelly is done and should be removed from the fire at once. But if the jelly is being prepared for transportation it may be cooked a little longer. This test however is not so easy as it appears, because the nature of the sheet varies with different juices and calls for some experience to enable one to perform the test with confidence.

2. Coagulation test.—Pour a drop of boiling liquid in a saucer containing cold water. If the drop coagulates in a thick mass the *end point* is reached and the jelly should be removed from the fire.

3. Thermometer test.—A more convenient method of determining the *end point* is by means of a thermometer. It is of great help in getting jellies of uniform texture, especially when several kettles of the same juice are cooked and a definite jelling point for the lot is determined. Most juices set between 218 to 222 F., with an exception of few juices which jell a degree or two higher or lower. Other things being equal the fruit juices gave very satisfactory results at the temperatures given in table V.

The thermometer test should not always be relied upon, because the temperature is bound to rise with higher viscocity. The thermometer test should be verified by the *sheeting test.*

4. Specific gravity test.—Although this test is most accurate, it is not very practicable because it takes a longer time and prolongs the boiling period.

Filling and sealing. —The method of filling and sealing depends upon the kind of containers used. In western countries, glass jars of various sizes and shapes and with various methods of hermetic sealing are used, such as metalclamp, glass top jar, Mason jars with lacquered metal tops, economy jars, vacuum jars and mason jars with zinc-top and screw-top jars. These jars are indeed excellent, but due to their high cost cannot be introduced in India at present. The screw-top jars or double lid screw-top jars, made of thinner glass than that used in western countries are quite cheap and satisfactory for Indian conditions.

Tins may also be used, especially for export; but jars are economical, in that they can be used repeatedly and their relatively high initial cost is offset by this advantage.

Wash and sterilize the glass jars by boiling them in water. Remove them from the water-bath and place them on a dry metal tray. The adhering water will evaporate in a very short time. Pour hot jelly immediately into the jars while they are still hot. Fill the jars to the top. As the jelly shrinks in cooling it leaves enough space for the paraffin seal. When the jelly has become cold and has set, cover it with the scalding hot paraffin in order to sterilize the surface of the jelly. Enough paraffin should be added and spread evenly so that a perfect seal is made. The best way to secure a perfect seal is to loosen the jelly from the wall of the jars to a depth of about half an inch by inserting a knife, dipped in boiling hot paraffin; between the jelly and the jar. Pour boiling hot paraffin, tilt the jar, allowing the paraffin to flow in this space.

The paraffin seal should be renewed in case it becomes loose or is broken during storage

Labelling.— Advertisement is the life of business. Labels do not indicate the name of the product only, but they speak for themselves, if they are appropriately designed. The labels should be judiciously designed with an outstanding trade-mark and should not be frequently changed, in order to establish good will.

Examine the seal and clean the jars thoroughly from outside and paste the labels on the dry jars and date each lot of the jelly. Do not delay labelling, otherwise there may be chances to mix up different jellies and they may be wrongly labelled. In order to avoid confusion, allot a separate shelf to each product and label the containers when convenient.

Storing.—Much less damage is done to the jelly during the processes of cooking than during storage. No matter how perfect the jellies are made, if they are not stored under ideal conditions, they are sure to deteriorate in firmness of texture, flavour and aroma. The factors that hasten deterioration are dampness, intensity of light and excessive heat. There are only a few provinces in India where the ideal conditions of storage exist, but it does not seem very expensive to provide such conditions in less fortunate places.

In order to cut off the light, the jars may be wrapped with wrapping paper and put in the same cardboard boxes in which they were purchased. Line internally the wooden packing boxes with black paper and pack the cardboard boxes full of jelly jars in them. Make a concrete platform three to four feet from the floor in a basement room, with the wall also plastered with a thick layer of cement plaster. Arrange the packing boxes full of jellies, etc., on this platform.

A CORRECTION

In the January issue of **The Allahabad Farmer** in the article on Lac Cultivation by Mr. P. N. Glover, B.Sc., an unfortunate error has crept in. On page 4, line 2, 80% has been printed instead of 8%.

Unto each man his handiwork, unto each his crown,
Whoso takes the world's life on him and his own lays down,
He, dying so, lives.

—*Swinburne.*

BEE-KEEPING IN INDIA

By

R. N. Muttoo,

Director, Jeolikote Apiary, Naini Tal.

Bee-keeping and honey-production have contributed to the well-being of the human race from the earliest times. Honey was the earliest source of sweetness in foods of which man acquired knowledge. Till the discovery of the sugar cane, honey was the only source which man possessed, and no wonder a very high value was set on it. With the discovery of the sugar cane the importance of bee-keeping diminished throughout the world, or rather in those portions of the world where bee-keeping had been known and where sugar cane was introduced. It was so much easier to obtain sweetness from sugar cane. It is not perhaps generally known that in Europe sugar cane cultivation did not become general till the time of the Stuarts. Alexander, when he found the sugar cane in India, called it the honey-bearing reed. We know that large apiaries existed in ancient times in Egypt and other places in the Old World. In the New World the honey bee was not known till it was taken there by the white settlers. Even today the native Americans call the honey bee "the white man's stinging fly". The ancients had a very high opinion of honey as a food and medicine. It was considered a panacea and miraculous powers were attributed to it. It was in demand for medicines and for all religious ceremonies. Its well-known anti-septic properties were availed of in surgery.

Though sugar cane brought a set-back to the bee-keeping industry of this country, still the industry survived in hilly tracts where sugar cane could not be grown and where communications were so bad that sugar and *gur* could only be obtained at high prices.

Today we are not so enthusiastic about honey, but its food value, specially for growing children and old men, is beginning to be recognised. Those interested in the subject are referred to that excellent book, "Honey and Health" by Dr. Bodog F. Beck of U. S. A.

There are three species of honey bees. Apis dorsata is the big bee, called *bhanwar* or *sarang*. This bee builds its nests in the open air high on tree branches or high rocks. It is also sometimes called the Rock Bee. It builds only a single large comb. Apis florea is another species, much smaller but with similar habits. This bee also builds a single comb in the open air. But the comb is not very large, sometimes only as big as the palm of a man's hand. The third species is Apis indica. This is the bee which is domesticated by man. In Europe, a variety of this bee exists and is called Apis mellifica. This bee prefers to live in the dark and builds its nest inside of hollow trees, crevices in rocks or old buildings. It builds several combs parallel to each other and is for this reason called locally by various names such as *sat-balla*, *sat-lahri*, *sat-khamba*, etc. The names indicate that it builds seven parallel combs in one nest, but this number is not fixed.

Apis dorsata is very common all over India. It is very hardy and appears to adapt itself to various climatic conditions. But it is so ferocious that all attempts to domesticate it have so far failed. Its nests yield huge amounts of honey· yields of over 1 maund are not unknown. The only thing that can be done is to improve the method of extracting honey and an attempt in this direction is being made in the United Provinces by the Forest Department and the Rural Development Department at the Jeolikote Apiary.

Apis florea is also very common but its honey yield is so small that it cannot be made a commercial proposition.

Apis indica is found in domestication in all the hilly tracts of India, but the methods of extracting honey are the same as have come down from pre-historic times. They involve the periodical destruction of the bees and their nests.

These methods are not only cruel, but uneconomical and destructive. Moreover, pure honey cannot be extracted this way and the produce, therefore, does not fetch a fair price in the market. The honey of Apis indica is considered superior to that of Apis dorsata. The honey produced in the month of Kartik (Oct.-Nov.) is specially prized.

The credit for making the first serious attempt to introduce the modern humane and clean methods of honey-extraction into India, must for ever, rest with that noble-hearted Englishman, Mr. John Douglas of the Telegraph Department, who, in 1881, approached the Secretary of State for India with a view to the introduction of this industry for the special benefit of 'the better educated natives' and Anglo-Indians. Though nothing actually came of it, enquiries were set on foot throughout India and the results were published in book form by the Government of India. This publication, now out of print, makes interesting reading and shows incidentally the amount of ignorance prevailing in high quarters about bees and bee-keeping.

It is indeed something of a tragedy that in India, the country where the honey bee had its birth, the bee is neglected to the extent that it is almost unknown and uncared for. Quantities are massacred every year for the sake of the honey they collect, little thought being given to the future of the race.

In the West the honey bee is regarded as "the best little friend of man". Besides giving honey to man, the honey bee is of immense use in the production of fruits and seeds. In the U. S. A. bee-keeping has received its greatest development. It is estimated that about a million people make money in one way or another through bee-keeping and some depend on bee-keeping alone for a living. The U. S. A. produces a total of about 15 crores of rupees worth of honey. Other countries, like Canada, New of Zealand, Australia are fast developing the bee-keeping industry. England and other European countries, excepting Russia, being highly industrialised, have to import honey, though bee-keeping is carried on even there on a much larger scale than in India. Russia has

demonstrated experimentally the great value of bees for the production of cheap abundant seed. Progressive fruitgrowers in the West arrange for bees to be kept on their orchards by paying bee-keepers. They realise the benefits which bees do to their fruit crops

In India, bee-keeping first obtained a foothold in the South. The State of Travancore began in 1917 and now boasts of 10,000 hives The Mysore State and Madras have also contributed to the advancement of bee-keeping. Father Newton of Trichinopoly may be regarded as the father of modern bee-keeping in the South. The hive invented by him and called after him is well-known and is used almost exclusively in the South to this day The work done by the Y. M. C. A. Rural Development Centre in Madras, Travancore, and Mysore deserves special mention.

Only very recently bee-keeping has been taken up in the North. The Punjab Government, and the A. I. V. I. Association at Maganvadi, Wardha, may be said to be the poineers in the North and Central India. Work has been going on since 1936. Bombay and the U. P. started in 1938. Now Central Provinces, Kashmir, North West Frontier Province, and several Native States are taking it up.

In the United Provinces, the Apiary at Jeolikote gives systematic training in all branches of bee-keeping, and students come from all parts of India. An All-India Bee-Keeper's Association has come into existence with a monthly organ, the "Indian Bee Journal", which is published from Jeolikote.

A good deal of enthusiasm has been aroused and the future appears to be full of promise. Much work has to be done before bee-keeping can be said to have made a fair start in India. In the very first place the good name of the Indian Bee, *i.e.* Apis indica has to be cleared. So far all the difficulties arising from bad bee-keeping or unsuitable locality have been heaped on the head of poor Apis indica. Wax Moth and swarming are two of the greatest troubles complained of by bee-keepers in

India today. So far as the Wax Moth is concerned, it is more a joke than anything else for the trained bee-keeper. Swarming is nothing special to India: it is known all over the world. It is certainly not worse in India than elsewhere. And the Indian Bee is extremely docile as compared with the European bee. And when bee-keepers in India complain of their troubles, they forget that in the West they have such things as "European Foul Brood" and "American Foul Brood" and bee-keepers there manage to produce quantities of honey in spite of it all. Today bee diseases are almost unknown in India.

To those interested in the subject, the advice is hereby given. The very first step for them is to read good books. Expenditure on good books is the best improvement a beginner can make. Bee-keeping is not difficult. Any intelligent person can master it. But it must not be imagined that all that is necessary to do is to buy a hive and keep bees in it. No one must think of buying bees or equipment till he has understood the theory of bee-keeping by studying some good books. To begin bee-keeping with hives and other equipments may be prescribed as a good way of losing money. A list of books which may be recommended is given below :

1. "Bee-keeping"—Bulletin of the Imperial Council of Agri. Research, New Delhi. Price Rs. 1-14
2. "Bee-keeping in South India"- Manager, Govt. Press, Madras. Price Re. 1.
3. Indian Bee Journal—Jeolikote, Dist. Nainital, U.P. Subs. Rs. 3 per annum.
4. ABC and XYZ of Bee Culture – Root. Price about Rs. 10.
5. Bee-keeping—Phillips. Price about Rs. 15.
6. Manual of Bee-keeping—Wedmore. Price about Rs. 15.
7. Starting Right With Bees—Root. Price about Rs. 4.

A keen man may support himself and his family on bee-keeping alone, but bee-keeping is advocated mainly as a part-time cottage industry. Rupees twelve per annum per hive may be taken as a fairly low nett income for the trained bee-keeper. And this income comes to him by his spare time activities. A man could easily look after 20 to 40 hives in his spare time by devoting on the average about two hours per day to the work.

Bee-keeping may be said to be of national importance in the sense that large amounts of extra food for the nation can be produced without adding to the pressure on the land and from sources at present going waste.

ONIONS

The onion is a vegetable of long pedigree. It was known to Alexander the Great; represented on Egyptian monuments; eaten by the Israelites; praised by Pliny and Horace. Its name, Allium Moly, recalls the fact that it has been identified with the herb Moly, given by Hermes to Ulysses to check the undesirable advances of Circe.

Onions have a definite medicinal value in addition to their value in general diet. For a cold or in cases of influenza there is nothing better than onion gruel. Troublesome coughs and certain cases of asthma can often be alleviated, if not actually cured, by chewing or sucking a raw onion. Onion broth is excellent for encouraging sleep.

Onions are most frequently used as a flavouring for stews and soups, but make a splendid separate course.

FARMING UNDER IRRIGATION

By

S. M. Wakankar

"The ideal farmer is first of all a student, then an investigator and finally a specialist; ever alert for new things and new ideas, open-minded and free from conceit, a man familiar with what is going on around him and yet intensely devoted to his own work."

William Macdonald.

In all arid and in some humid regions, there are times when it is advisable to increase the moisture content of the soil for the best growth and development of crop plants. This is done by adding water to the soil by irrigation.

The common and the least expensive source of water for irrigation is found in running rivers or streams. A suitable dam is placed across the stream at advantageous position to store the maximum amount of water. This water is turned into canals and distributaries and utilised whenever or wherever required The head of such canals is sometimes many miles from the farms and the cultivated fields. The capital outlay is usually heavy in such canal projects; it represents but a small fraction of the benefits rendered to agriculture and a good source of increased revenue to the state.

Usually water is applied to land by two methods: furrow and flooding. In the first, water is run in furrows and allowed to soak into the ground between the rows. It can be used for crops that require interculture and has the advantage of not wetting the entire surface leading to reduced evaporation. This is possible with crops sown in lines. A small stream of water can irrigate a greater area of land than by the other method. The flooding method is used mostly for the small grains where water is flooded over the entire field in 'kiaris', and is possible on land with an even slope.

Now, handling canal water is a task of great responsibility. It has been found that farmers usually over-irrigate

their fields. To irrigate when not required is waste of time and water both of which are precious. In this country a farmer can give any amount of water to his crop provided he does not waste it. The fixed water rates for particular crops places no binding on the farmers to use water economically Illiterate and ignorant as they are about irrigation matters they are constantly damaging their fertile lands with over irrigation. They try to make up for lack of tillage and manure by application of extra water, little knowing that instead of increasing his output he is destroying the productivity of his land.

The amount of water to use depends to a considerable extent on the amount available, the nature of the crop and the type of the soil. Crops vary in their water requirements and even the same crop does not require the same amount of water in all climates and in different types of soils. Even the varieties differ in their water requirements. Such are the factors which are considered when determining the amount of water to be given to different crops.

For all crops there is a definite amount of soil moisture which is best suited for the optimum development of a particular crop This ideal condition is difficult to maintain, but a suitable time for irrigating is just before they show a tendency ot temporary wilting. There are certain critical periods in the lives of crops when they are especially affected by drouth. With grain crops this critical period commences after head formation. Good germination and a good start are very important as they actually affect the yield. If sufficient moisture is supplied to make this possible, plants often pull on without any additional water till they come to the blooming stage. Deep soils need few heavy irrigations, but on shallow or sandy lands it is necessary to apply water often. Deep-rooted crops can go on without water for much longer time. Thrifty use of water promotes deep rooting and does not hinder root aeration which is so very important for the best growth of plants.

Continuous application of water to land demands the maintenance of proper physical conditions of the soil. This is done by draining off the excess water applied. If the sub-

soil is a sandy loam or consist of murum both of which help in draining, the damage is less; but in deep clayey soils like the black cotton type, where drainage is bad, irrigations are dangerous which cause accumulation of salts.

Alkali soils are caused by the accumulation of salts in the surface layer of soils. By capillary action these salts come up and after a number of years salts accumulation gets so heavy that crops cease to grow and the land becomes barren. The injury thus done to crops results from the shutting off of water from the plant on account of the soil solution having greater concentration than the plant sap. By osmosis water passes from the dilute to the more concentrated solution. In this case water passes out of the roots into the soil resulting in the death of the plant. The above soils are distinguished by stunted, sickly yellow crops if at all growing, or by the white deposits of the salts on the land. Low lying area tend to become alkali soon.

The remedy of reclaiming salt land lies in draining off of the accumulated salts from the surface to the subsoil—beyond the range of roots of cultivated crops. This drainage is effected by digging drains 2½ ft. deep across the line of natural drainage round ¼ to ½ acre plots and banking them. These plots are then ploughed and flooded with canal water, about 3 to 5 inches deep. The water is allowed to soak into the soil. This water drains out through soil carrying off the excess salt. Alkali land so treated can be improved in about four years. With a liberal use of farm-yard or barn-yard manure, rice may be grown. This crop is known to be resistant to salt. In alkali lands the percentage of salt in the upper six inches of soil is about 0·4 to 0·7 per cent.

Now, having dealt with the problems of over-irrigation, we come to the crops which may be paying to canal farmers. The following crops can be raised on canals profitably:—Sugar cane, improved wheats, irrigated cottons, paddy, turmeric, potato, tobacco, ground nut, fruits and vegetables. Final selection of crops should be made according to conditions in the locality. For example, sugar cane can be grown on a large scale only if there is a sugar factory somewhere near-by to consume the product or if there is a power crusher and improved appliances for converting sugar cane into *gur*.

Fruit and vegetables may be very profitable near a town or city.

The size of a profitable farm is difficult to determine. It depends on the type of soil, labour and other local factors. In the United States of America, in drier regions, a 300 acre family farm is considered ideal. In India too, to support an average family in a decent way, and providing a suitable crop rotation, the farm should be as big as 100 to 150 acres A larger area is sometimes difficult to control. But for intensive farming under canal irrigation a 30-50 acre farm will be found suitable. On large farms it is not possible, and advisable to have this whole area under irrigation, for part of it can be utilised for grazing purposes and part for the dry crops like *juar*, gram, linseed, *arhar*, etc Such dry crops apart from being necessary to the farmer in more than one way will serve the purpose of rotation in between wet crops thus helping in preserving the physical tilth of the soil.

Improved crop cultivation demands the use of iron plows which are more than necessary for many reasons. Sabul, Punjab and Meston plows are very good for different purposes. Ridgers are necessary for sugar cane cultivation. A ridging plow though costly, does the work of opening furrows more efficiently and the Sabul plough reduces the cost of earthing up. Mowing machines, rakes, cultivating and weeding appliances are also indispensible.

Lastly, in wet-farming, the importance of manuring should not be overlooked. Irrigated crops always respond favourably to manures. Green manuring should be introduced as a general routine practice where farm-yard manure is not available. The application of concentrated manures for top-dressing, for instance oil cakes, ammonium sulphate, potash mixtures, etc, for crops like sugar cane, potatoes, tobacco, and vegetables, often pay.

A farmer's job is difficult and one which requires perseverance. However he may find gardening, the raising of poultry, and bee-keeping, interesting and absorbing. Gardening, apart from making the homestead on the farm beautiful will provide the farmer with additional work for his spare time, while poultry, husbandry and bee-keeping will be additional sources of income.

BREEDING OF DISEASE RESISTANT CROPS

By

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Enormous Loss Caused by Plant Diseases :—The rust disease of wheat takes away a regular toll in all the wheat producing countries of the world. Butler stated that probably 4 crores is not above the annual loss to India due to wheat rusts. The greatest injury results in years of widespread epidemics. During the epidemic of 1904 in America much of the grain produced in the northern section of the Mississippi valley was so badly shrivelled that it was entirely rejected by the market the yield dropping to 4 bushels per acre. (Carleton 1905 . In this epidemic the reduction in yield for Minnesota, N. Dakota, and S Dakota, which include the important portion of the spring wheat belt, was estimated in excess of 23,000,000 bushels valued at nearly $16,000,000.

The producing of immune varieties of plants is the most modern phase of plant disease control. The primary stimulus came from the work of Orton and others. Orton produced strains of cotton, cowpeas and melons resistant to Fusarium wilt (1899 to 1909). With the increased emphasis on breeding in relation to agriculture, plant breeders are becoming pathologists and pathologists are becoming plant breeders.

With the clue afforded by the discovery of Mendel's laws, plant breeders, the whole world over, are attempting to introduce new varieties of cultivated plants which will be more resistant to disease than those grown formerly. Many varieties of plants which are highly resistant to disease are of little or no commercial importance because of low cropping capacity or of some other defect. Plant breeders now have in their power to combine the character of disease

resistance of one variety with the heavy cropping capacity or other desirable quality of a susceptible variety.

This is due to Gregor Mendel who gave us a thorough conception of the laws of inheritance. The importance of his work has recently been brought to light. Though the science of genetics is young, yet it is fairly established and has developed rapidly. The knowledge of the laws in their present form has already led to synthesising of "superlines" of maize and of varieties of wheat resistant to all the physiological races of stem rust The progress has been so rapid as to venture us to say, "It is not too much to expect that eventually our more important crops at least will have been subjected to such thorough germinal analysis that the establishment of desired strains will become largely a matter of reference to breeding records and the repetition of certain crosses and selections".

Mendelian Conceptions.—To Gregor Mendel (1822-1884), monk and abbot, belongs the credit of founding the science of Genetics In the seclusion of his cloistered garden, in his monastery at Brünn in Austria, he carried out with the common pea the series of experiments which has since become so famous. In 1865, after 8 years of experiments he published his results in the proceedings of the Natural History Society of Brünn. For 35 years Mendel's paper remained unknown and it was in 1900 that this important paper was simultaneously discovered by several botanists

Mendel, among other things, simplified the problem of heredity by introducing the conception of unit characters. Each organism appears to us as a microcosm, consisting of thousands of elementary entities, which combine to give it its form and functions. Mendel then crossed plants exhibiting a limited number of characteristic differences and systematically studied the successive generations of progeny. He started with parents having characters strikingly different so that there would be no difficulty in telling which parent the offspring resembled In certain cases the hybrid is not intermediate between its parents, but bears the characters of one of them. In other crosses the result is not complete

dominance of a particular character but is a blend with or without a preponderance in favour of either parent.

Wide as are the prospects of solving the most difficult problem and tempting as it is to indulge in a discussion of the possibility of the discovery of the ruling laws on the ground of principles of units, we must of course, now limit ourselves to questions more directly connected with plant breeding. Among these the chief point is what is to be considered a *unit* ? We may be content with analysing the visible characters and reducing them to independent groups, or we may ask for some invisible, although material cause, which constitute the real source of each *unit*. The latter is wholly of a hypothetical nature. Among visible characters a unit may not be limited to one organ, to one tissue or to one cell. On the contrary it seems possible that a unit may show its activity in different organs, sometimes even in almost all parts of the plant. The conception affords a broad principle for the explanation of a large group of correlations, the correlated external marks being simply assumed to be the expression of the same internal characters. The faculty of producing a red or blue colour may be taken as an instance.

Crosses may give us an insight into the nature of unit character. Many so-called characters are in reality composite entities and it is by means of crossing that they can be divided into their constituent units. It goes without saying that these splittings may not only be produced by artificial crosses, but most occur also whenever accidental crosses are brought about by other than natural agencies of pollination, such as insects visiting the variety and the species when cultivated or growing near. If this takes place in a horticulture garden, the horticulturist will recognise the new types and isolate them as such and place them on the market. This will prove to be constant or will become so after some additional splittings.

The splitting of unit characters may be proof of their real existence. Our conception of units was originally based on the desire of having some principle which might explain the internal causes of correlations, or at least some of them.

Thus the botanical marks observed in the scales of an ear of wheat or barley may be indication of hardiness in winter, or fitness for definite commercial purposes, of resistance to diseases, and other valuable qualities. In order to explain such coincidences, we have assumed that unit characters are not productive of single marks but may exhibit their influence in different parts of the plant body. The same unit may exhibit its influence in different parts of the body. The same unit may become visible in the colour of the stem, foliage, flower and fruit and so it must also be with other units, which when added to a type not only change its flower and leaves but also affect other organs, physiological qualities and perhaps even the whole mode of growth and development. For direct proof of this assertion comparative study may not be sufficiently reliable.

It is a much discussed question whether new characters may be produced by crossing. Of course there is no doubt that new varieties and new races may originate in this way but this is not the same point. It is well known that large number of hybrids simply owe their characters to a new combination of qualities. It is the combination that is new, not the qualities themselves Some characters are derived from one parent and some from the other Each of them may be simply inherited in the same way as in the case of pure descent. But by their new combination they yield varieties of higher practical value. Notable examples are afforded in the case when one parent has contributed vigour of growth, hardiness in winter, resistance to diseases, or productivity; and the other bright flowers, palatable fruits or nutritive seeds.

Variability :—It is a universal fact that no two individuals are alike, and the offsprings of the same parent vary in some respects. We can search new characters among variations of a species. These variations are of various kinds :

1. Developmental variations are due to environmental factors or due to use and disuse (Lamarck's hypothesis).

2. Mutations which may be due to:

(*i*) Alteration in the genetic constitution, and

(*ii*) Chromosome aberrations.

From time to time one single specimen among hundreds of thousands will sport, deviating in some mark from the main type.

3. Selection in all its forms may bring about variations in animals and plants

4. Variations may be due to horticultural operations, etc.

Mendelian variations depend upon difference in Mendelian factors, which exert their characteristic effect even when individuals develop under as nearly indentical environmental conditions as it is possible to supply. These variations arise as a result of reshuffling of factors governed by Mendelian laws. These variations occur in nature also, but among cultivated plants such variations have been produced by the breeder. Indeed the aim of the hybridizer is to upset the constancy of his plants, and to bring them into a state of unstable equilibrium which in the end will result in an extreme chaos of forms. From this chaos, he makes his selections, and if they do not at once comply with his wishes, he continues his crossing in order to widen still more his range of types. The breeder is careless as to the source of variations but he is very careful about the choice of the starting point for his work. Species, elementary-species, varieties, individual excellences, have to be tested with the utmost care before being allowed an introduction into the strain. For the crossing with indifferent types would increase the work without affording any real chance of progress, and species possessed of some undesirable character might, of course, transmit this to the hybrids, as well as any favourable quality. They must be excluded at the outset, and this requisite is of so essential a nature that it might be said that half of the ultimate result depends upon the initial choice and only the other half on the success of the ensuing hybridizations. Half the battle is won by the first selection. Simply the new

groupings of what is already present is the source of the almost inexhaustible variability.

Varietal Resistance :—1. *Immune and non-immune plants*:—Individual human beings differ markedly in their susceptibility to particular disease. In plants which are much simpler in organisation than the higher animals, differences in reaction to disease are characteristic of the closely related varieties. It is rare for the individual members of a variety of a plant which breed true to type to differ appreciably in susceptibility to a specific disease in the same locality.

2. *Acquired immunity not known in plants*:—An important difference between plant and human disease lies in the fact that there is extremely little evidence of anything of the nature of acquired immunity in plants. In recovery from certain human diseases especially from those of a parasitic origin, the individual is often rendered immune or very resistant to another attack for a considerable time. With plants recovery from disease generally confer no degree of resistance against second attack.

3. *Varietal resistance or specific immunity* :—Naturally therefore importance has to be given to the immune varieties. In truly immune varieties the presence of the fungus causes no obvious response on the part of the host and the fungus dies in the cells of the host. Ward (1905) and others have come to believe in the physico-chemical reactions of protoplasm. The development of the germinating spores of the disease is modified according to the degree of resistance. In cases of high resistance there is no effect on the host and the fungus perishes after some time, due to inability to secure protoplasmic connections. In lesser resistance a weak development of mycelium might give rise to spores, the ultimate result varying according to the degree of resistance.

Many explanations of this resistance are given in specific cases. Whether resistance is structural or physiological, the plant breeders all the world over have shown that

susceptibility or re istance to a particular disease were definite hereditary entities, transmitted according to Mendel's laws. Biffen investigated by comparing the rust resistance of several hundred distinct varieties of wheat grown under similar conditions. The determinations were repeated for several years and it was found that varieties could be grouped into a number of arbitrary classes showing no diseases at all, traces, or slight, or moderate or bad attacks. These varieties always fell into the same class in different years and this in spite of varying intensity of the attack in different years.

Selection and cross-breeding of wheat and other crops resistant to all the physiological races of stem and other rusts is in progress and considerable success has already been claimed by many workers.

Hybridisation:—(1) *Methods:*—Variability has been the main source in all selections A thorough examination of all the characters has to be made before crossing. Such an examination of all the important types has been made or is in progress at interested centres Workers at various stations have shown that ordinary cultivated cereals and other crops are not pure but must be considered as mixtures of well-known types. Moreover they have shown that these types are far more numerous than was previously supposed and include hundreds of forms within each of the now prevailing sorts. They also show that all the differences among these newly-discovered elementary types are far greater than might be suspected by the study of earlier isolations. The range of variability disclosed is so wide that it appears to afford all the material for desired combinations. Selections of parent with desired qualities is the intitial step. The selection should be made in the field. The search in the field is made on the basis of marks which can be recognised instantly by the experienced eye, upon a simple inspection of for example, the ears. Thus the purely morphological distinctions take the place of the agricultural tests, which embrace measurements and estimates. The field selection should be followed by tests in the laboratory by the help of special instruments for measurement and comparison.

The general process of breeding includes emasculation and bagging of a female parent before the flower bud opens, protection of pollen parent in the same way, application of ripe pollen to receptive stigma, bagging pollinated flower and attaching labels containing necessary data. The female parent should be always written first. A corresponding record is made in the note book. The details of hybridization methods vary for each species or even for each variety in some cases. For wheat breeding the basal spikelets are stripped off and also the top third of the head. The four or five remaining spikelets contain three to five flowers each. Of these all except the outer pair of each spikelet are removed, thus reducing the ear to 12 to 20 flowers. By gently inserting the point of a closed forceps the anthers are removed. If anthers are shedding pollen the flower is rejected and the forceps sterilized before operating on the next flower. Having removed the anthers the head is wrapped in a paper bag, cotton cloth or manilla bag, until the stigmas become receptive. Then remove the covering and from the desired parent (male) secure ripe anthers just ready to burst. Break them into halves and dust the contents over the feathery stigma of each flower in succession.

Although a single pollen grain is sufficient to effect fertilisation it is more certain if a liberal quantity of pollen is applied on the stigma. All self-fertilisation should be avoided. It is well to remove this protective covering about 2 weeks after pollination so that it will not interfere with normal ripening. Check experiments should be made to assure that self-pollination does not occur or if it does, to what extent. Some of the seeds may result from parthenocarpy and these will not be viable. With slight modification these directions can be adopted for flowers of grasses, barley, oats, etc

Seed is collected and the seedlings are raised in a nursery bed, say ten feet square which is properly manured These are then transplanted and are spread between rows. The distance between the rows and the plant varies. The plot is protected as effectively as possible from the contamination

by pollen from unbred varieties. Protection by hedges or timber is too cumbersome and it will hardly be possible to place it on good soil at a sufficient distance from the remaining fields. The best plan is to place it in the midst of a field of selected strain. Attention is to be given to the directions of prevailing winds. Various other precautions are taken in the special cases. Seed is then collected.

(2) *Some Results*:—Epoch-making has been the production of rust-resisting types by Sir R. H. Biffen by a cross between Michigan bronze,—no single individual of which escaped the rust and so badly were the plants of this strain of wheat diseased that very few ripe grains could even be obtained from them, - and another strain which was apparently quite immune and never showed a trace of infection.

One of the finest achievements of the Agricultural Department of India is the production of a number of new wheats (Imperial Pusa 4, Imperial Pusa 12 and Imperial Pusa 52) which combine high yield, good milling and baking quality, strong straw and resistance to rust. Pusa 114 is particularly characterised by stiff straw and high resistance to loose smut of wheat (*Ustilago tritica* (Pers.) Jensen). Another new wheat, Pusa 120, is outstandingly resistant to the physiologic races of yellow rust occurring in India. Recently the breeding of other rust resistant wheats has been taken up.

The National Agriculture Board of England has reported the production of a new variety of potato which is immune to the wart disease and combines the good cropping, cooking and keeping qualities.

Hybrids of sugarcane with *Saccharum spontaneum* produced by T. S. Venkataraman have been noticed to be generally not susceptible to smut, which is otherwise a common character in Indian canes.

At Sakran (Sind) 4F Punjab American cotton, a resistant type, has been crossed with Meade upland cotton, with the object of improving the staple of 4F which is the

hardiest and most prolific cotton for Sind and is fairly immune to red leaf blight.

The Agricultural Department of Bombay has evolved new strains of cotton which are wilt resistant and have better staple and gin higher. The extra profits to cultivators in Karnatak alone, by the extension of the new varieties, is well over 12 lacs per annum.

At Dacca a high yielding and disease resistant type D154 of *Corchorous capsularies L*; has been introduced.

A blight resistant gram has been produced after 7 years' effort. A type of groundnuts resistant to *tikka* disease has also been evolved.

As large number of forms within a species can be distinguished and as neither the time nor the memory of one man was sufficient to embrace the whole realm of the botanical marks and of their correlations to breeding qualities for all the elementary forms of more than one or two species, hence there is need for specialisation. As at Svalof so in India the posts of economic botanists are being duplicated and thus relieving some of them from the teaching work and in some cases crop specialists for cotton, fibres, rice and millets have been appinted in addition to the ordinary cadre. Each of them, already a specialist, becomes a specialist in his line and acquires a high degree of ability in singling out the promising individuals.

Conclusion: – In recent years great stress has been laid upon the modification of disease resistance by environmental condition. Yet the quality of resistance of the variety is present even though it may be partly masked by by the influence of an adverse environment

The work of Miss Newton, Stakman, Piemeisel and others who have drawn our attention to the occurence of several biological forms, say under *Puccinia graminis tritici*, brings about further complications to unexpected difficulties which are sometimes encountered in breeding work.

Besides, all nature being in a flux when any long time is taken into consideration, it is possible that pathogenic organisms may change and attack the hitherto resistant varieties The best results are to be achieved by the

mutual co-operation of the plant breeder, and plant pathologist and the farmer, who if he is not intelligent enough to put forward his demands should be willing to take suggestions and introduce new types. Again it is possible that fortunate plant breeders may be able to produce varieties resistant under fairly different environmental conditions and perhaps resistant to more than one biological form of the parasites.

Considerable progress has already been made and this work has proved beyond doubt that great progress is possible.

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"JHUM" CULTIVATION IN THE HILLS OF ASSAM

BY

U. MAWSING KHARSATI.

Jhum cultivation is quite unknown in the United Provinces and many other provinces in India.

This cultivation is followed in the hills of Assam to a great extent, and in some parts of Burma as well where vegetation is so luxuriant and where rainfall is plenty.

Cultivation of this kind requires a good deal of wood and other plants, to be used as fuel. The chief benefit of this is the ashes obtained which no doubt is rich in potash salts.

The method of preparation of the *jhum* cultivation according to that seen in the tableland of Khasi Hills is as follows :

During winter, just towards the end of November and the beginning of December the forest covered area is cleared of all the underwoods and thickets, and the trees are thinned to such an extent as to allow light to pass through to the surface of the ground ; and branches also are lopped off to a great extent.

The underwoods, branches and thickets are accumulated in a heap or spread out like a mattress. This heap of wood and thickets are 5 to 6 feet in breadth, and 20 to 30 feet in length, depending on the topography of the land. The thickness of the heap should not be more than a foot. This is carried throughout the winter up to the month of January when the branches get dried, and are quite suitable for burning Then the next operation is to cut the grass land into slices of about $\frac{3}{4}$ to 1 sq. ft. These slices should be thinned to about 2 inches only. Some of these slices are laid on the heap upside down, and also on the spaces left between the heaps which are about 4 to 6 feet apart. When the slices get dried up, the farmer covers the heap into a thick layer of slices in such a way as not to allow the soil to go down into the heap Loose soil is added from time to time, so that the upper layer is quite thick. The sides of the heap should not be closed or covered. After that, fire is set to it at the top and on both sides of it.

The fire slowly burns the wood and branches and the grass slices, and reduces most of the soil into a brick-red colour. The residue left is ashes, charcoal and burnt soil. This residue becomes the seed bed. This bed may be used for cultivating potato, rice or millets.

When sowing is finished, fresh soils are covered on the upper surface so that ashes will not be blown away by the wind, and little drains are run on all sides to prevent water from washing away the seed bed.

As soon as the first rain is received, the seeds germinate and send out their shoots

All crops suitable for the locality are found to grow best in this way, for ashes serve as a good manure and prevent white ants from attacking the plants.

As the main crop of potato which is grown in the summer is cultivated, maize is sown or cabbages are transplanted at the same time. Later the potato is harvested but cabbages and maize continue to grow until the former are harvested in July and August and the latter in November. In the next year sweet potato is planted. In the third year, root crops, such as *sohphlang* are planted; and in the fourth year millets are grown. This last is sown along with pine seeds to prevent the young pines from being grazed by the cattle.

In a year or two, the land is again covered with a thick coat of pines and vegetation, till it is ready again for the next cultivation.

In areas of low rainfall and of poor vegetation this cultivation is not practicable. But in areas of luxuriant vegetation and heavy rainfall it is quite good, as it helps the farmer to fight against the encroach of the forest and weeds. But *jhum* cultivation is also a great menace to the country as it encourages erosion, and reduces the fertility of the land. The practice also gives a great impetus to floods which do a great damage to the plains below Still it is very hard to induce the hill people to give up the practice as it helps them to control wild animals and as they have no manure to use in their fields.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCES

FOR DECEMBER, 1939

I.—Season.—There was no rain during the month of December, 1939. Rain is generally needed specially in unirrigated tracts.

II.—Agricultural Operations.—Agricultural operations are up-to-date. The irrigation of *rabi* crops and poppy and the pressing of sugarcane are in progress.

III—Standing Crops and IV.—Prospects of Harvest.—The standing crops are doing well and prospects are generally favourable, but much will depend on future rains. The average outturn of sugarcane is estimated at 14 annas.

V.—Damage to Crops.—No serious damage to crops is reported.

VI.—Agricultural Stock.—The condition of agricultural stock is satisfactory. There is a marked increase in the cattle diseases as indicated by the following figures furnished by the Director of Veterinary Services, United Provinces:

Diseases	November, 1939		December, 1939	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	1,094	651	3,298	2,067
Foot-and-mouth	3,621	15	7,439	41
Hæmorrhagic Septicaemia	167	140	235	171

VII.—Pasturage and Fodder.—Fodder and water are sufficient everywhere.

VIII.—Trade and Prices.—Prices of all chief food grains have slightly fallen as will be seen from the following

figures comparing the average retail prices in rupees per maund at the end of the month with those of the preceding month:

			End of November, 1939	End of December, 1939
Wheat	...	...	3·964	3·962
Barley	...	...	3·066	3·045
Gram	...	...	3·859	3·880
Rice	...	...	4·484	4·397
Arhar dal	...	...	5·131	5·041

IX.—Health and Labour in Rural Areas.—Ample employment is available for the labouring and agricultural population. Public health continues satisfactory although small-pox is still reported from certain districts.

For January, 1940

I.—Season.—The first two weeks of the month were practically rainless. The rainfall in the last two weeks was general and above the normal in some districts being beneficial to the standing crops, while in other districts it was either normal or below normal.

II.—Agricultural Operations.—Agricultural operations are generally up-to-date. The crushing of sugarcane, preparation of land for sugarcane and extra crops and irrigation of *rabi* crops are in progress.

III.—Standing Crops and IV.—Prospects of the Harvest.—The standing crops are doing well and prospects are generally favourable. The recent rains have improved the condition of the crops in dry areas.

V.—Damage to Crops.—No serious damage by frost is reported, except red-rot in the Eastern districts in sugarcane.

VI.—Agricultural Stock.—The condition of agricultural stock in fairly satisfactory. There is a slight increase in

foot-and-mouth disease as compared to the previous month, but the mortality is not high. Other cattle diseases are subsiding as is indicated by the following figures furnished by the Director of Veterinary Services, United Provinces :

Diseases	December, 1939		January, 1940	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	3,298	2,067	2,515	1,336
Foot-and-mouth	7,439	41	8,562	24
Hæmorrhagic Septicaemia	235	171	54	42

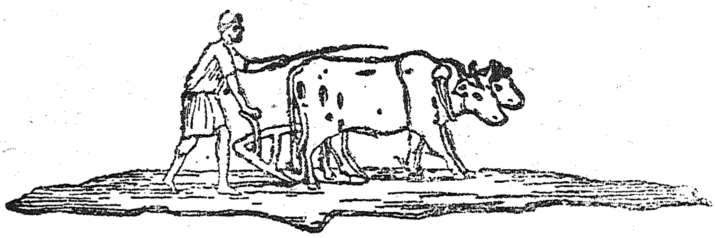
VII.—Pasturage and Fodder.—Fodder and water are reported to be sufficient almost everywhere.

VIII.—Trade and Prices.—Prices of the chief food grains such as wheat and barley have slightly risen, while that of gram, rice and arhar dal have slightly fallen. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

	End of December, 1939	End of January, 1940
Wheat	3·962	4·049
Barley	3·045	3·138
Gram	3·880	3·878
Rice	4·397	4·387
Arhar dal	5·041	4·907

IX.—Health and Labour in Rural Areas.—Sufficient employment is available for the agricultural and labouring classes. Certain cases of small-pox are reported from five of the districts, otherwise there is nothing to comment.

THE
ALLAHABAD FARMER



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An Editorial.

The All India Cattle Show of 1940

This is the third All-India Cattle Show and which has now become an annual feature held under the auspices of the Imperial Government. It was held this year again in the Irwin Amphitheatre in New Delhi from the 12th to the 17th February, under the kind patronage of His Excellency the Viceroy and Governor General of India.

The show this year was even more successful than those of the previous two years. The show demonstrated more clearly than ever before India's great wealth in good breeds of cattle, for altogether cattle representing more than 25 good breeds were brought from all over the country for competition in the show. The show also afforded an opportunity for breeders in foreign countries to get first-hand knowledge about Indian breeds.

We congratulate the Executive Committee for the excellent arrangement which was made for the show, and we also offer our hearty congratulations to all the prize-winners of the show. We wish the All-India Cattle Show a continued success in the coming years.

Agricultural Research in the United Provinces

During the last few years the people of this country have shown a great deal of interest not only in rural matters or village reconstruction but more particularly in the agricultural development of the country. In fact it would seem as if everybody now, from the highest officer of the land to the least of India's public men, are intensely interested in the agricultural progress of the country. The people of this country are now rural-minded, something which we could not have said a few years ago. So this is all to the good.

One of the results of this rural-mindedness on the part of our public men is the creation of a committee known throughout India as the I. C. A. R. or Imperial Council of Agricultural Research. This council in the short space of time that it has now existed has been able not only to stimulate agricultural research throughout the country but has also made it almost impossible for any research worker to go on with his work of research in a slipshod manner that at one time characterises most of the research work in the country. The result of this scrutiny on the part of the I. C. A. R. has made almost every research worker in the country revise his technique, that we do not hesitate to say that the output from the research workers during the last few years has been of a fairly high standard. There is of course a great deal of work that even now cannot be considered as being particularly good.

One of the greatest achievements in agricultural research during the last few years is the evolution of improved types of sugar canes which are now largely grown in all the sugar cane tracts of Northern India. Co. 312 cane and Co. 385 are some of the most outstanding achievements in this line of agricultural research, which have greatly benefited the cultivators of this province.

These beneficial results on this one crop we hope will soon be surpassed by those to be obtained in other crops. The study of rice in Nagina, the results of which have already been passed on to the cultivators of the province, the

(*Continued on page 147.*)

CROP IMPROVEMENT BY SELECTION.

By

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The method of crop improvement by selection which has only recently been raised to the status of science has been much in vogue with experimenters in this country who are trying to bring about improvement in crop plants. The practice of sieving cereal grains and selecting bold seeds for sowing purposes the selection of more vigorous plants from a field; all speak of the importance attached to selection. The results achieved by the above methods in the past were more or less insignificant, as plant breeders did not appreciate the main principles which make selection effective.

Necessity for selection :—It is by no means uncommon to find an otherwise ideal crop handicapped by some sort of short-coming, say of resistance to frost. It is also not uncommon to come across the different components of the crop having varying degrees of resistance to cold. The only direct method to effect an improvement in the direction of resistance to cold is to separate the different components of the crop showing varying degrees of resistance to frost, and ultimately multiply the one which shows the maximum resistance. Often it happens that with the growth of the crop subnormal conditions are encountered ; and the cheapest and the quickest method is to practise selection for the character which responds favourably to such conditions. That is to say, from a crop any number of strains can be evolved suited to certain conditions and demands. The case of Uganda 4 cotton and edible mushrooms *(Morchella esculenta)* are examples showing the potency and capacity of the method of selection. The former being an example of the capacity of selection, as the cotton plant yielded to selec-

tion under varying conditions of Africa ; and the latter showing the potency of selection, as the edible mushrooms come from a whole lot of poisonous varieties. The importance of selection therefore is too obvious to need more empahsis.

What selection actually does:—Prior to the discovery of the laws of inheritance, Mendelism as it is called, which deals with the behaviour of heterozygotes, little was known regarding the real part played by selection. It is why we find Darwin laying so much stress on selection in his theory of natural selection. According to him selection is the main agent that brings about change in the organism. To-day however we know that any amount of selection in a heterozygote will not fix a type, as it will always seggregate, and that is why attempts to fix the Andalusian fowl and the Dexter breed of cattle always failed. The real part played by selection in the evolution of better types from a population was discovered by Johannsen, who not only demonstrated the presence of several lines in a population of beans, each line breeding true to a certain mean value, but also showed that selection of extreme fluctuants either high or low in a line produce no genetical change. That is to say, selection did not materially change the mean value of that particular line. Guiding by his results he enunciated the principle of pure lines and concluded that selection within a pure line is ineffective and does no more than to isolate the extreme types from a population.

A recent report on researches on the selection effects within a pure line, namely the "Selection effects on Sea Island cotton selfed for nineteen generations" reported by Dr. S. C. Harland in the second conference of the Empire Cotton Growing Corporation, 1934, act as an eye opener at least with regard to the validity of pure lines. He has not only shown that at least in cotton the production of a pure line is well nigh an impossibility, but has also shown that selection continued to be effective thoroughout the period, and improved the characters under selection far beyond the range of the original material. A case of a similar nature has been also reported in maize by Winter from America. Maize was being selected for low and high protein and oil

right from 1896, and the results of only 28 years of selection up to 1924 have been reported. The most remarkable thing is the magnitude of the change brought about by selection. It was also found to be effective throughout the period The results of the oil content only will be described, those of protein were similar. In 1896 the mean oil content of 163 ears was 4·68%, the highest and the lowest values occurring being 6·0 and 3·9 per cent. respectively. Selection was both for high oil and low oil content. It continued to be effective for the whole of 28 years and gave little sign of slowing down by the end of the period. By 1924 the mean percentage was 9·86 in the high line and 1·51 in the low line—a specially striking result in that new values are far outside the range of variation from 3·9—6·0, found in the original 163 years The extreme variant in the original population was only 1·32% above the mean, yet selection raised the oil content by no less than 5·18% above this mean— far outside the original range. Now these results might have been produced due to the fact that selection was not stringent. Maize is a cross-fertilised plant and after the first nine years special measures had to be taken to ensure cross-pollination and thus prevent the loss of vigour from inbreeding. Consequently when a plant bearing seeds rich in oil is selected, the pollen parent of these seeds might carry factors for low oil content, and many of the seeds would give progeny inferior to the mother plant. Furthermore the character is one that is subject to much fluctuation, so that an ear selected may owe its high oil as much to environment as to genetical factors.

The important fact is however that selection should give a race with a mean so far outside the range of the original population. The most likely explanation of this may be either that the number of factors for oil content is large or one or more mutants for high oil content had occurred during the experiment and had been selected. Concerning the number of factors "student" points out that most of the individuals in a random mating population, having a large number of factors for oil will be heterozygous for many of these factors. Thus if ABCD give high oil, and abcd give low oil, then the heterozygotes such as AaBbCcDd, AABbCc Dd, and so on will be common but the homozygotes

AABBCCDD, and aabbccdd, which would give maximum and minimum values would be very rare. With a large number of factors as is generally the case with quantitative characters, the extreme forms finally selected would give an oil content far removed from the numerous heterozygous intermediate forms. "Student" estimates that the result like that of Winter's will be produced at least by 20 to 40 factors, possibly far more, assuming no change taking place after 1924. Whatever conclusion be reached about the number of factors needed to explain the above result it will still be true that a big change has been brought about by selection.

The conclusion drawn from Winter's and Harland's experiments recalls the geneticist's contention that selection can do nothing but selects the best of the existing types. This contention is based on the pure line principles of Johannsen, who showed that selection of extreme fluctuants did not effect any change materially in a line, but what he did not show was that all his plants in a line possessed the same genetical constitution. A mutant say for greater oil content occurring in a plant of a pure line will not be different from its sister plants, but will be certainly different in its power of raising the mean oil content of its progeny, and will give rise to another pure line making the former line heterozygous. If the rate of mutants be appreciable, results described as above and pointed already are possible, and the production of a pure line difficult. What should therefore be done while selecting is that the criteria of selection of a plant should not be its performance but the mean performance of its progeny.

Quantitative characters are generally governed by a large number of factors, and nothing better can explain the effect of selection for those characters than to quote "student's" (1933) own words that "In ordinary times these (genes) would roughly neutralise one another, each individual carrying a mixture of genes which would produce variations in opposite directions so that only a limited genetic variation will result, but with a change of environment this reservoir of genes would serve a very useful purpose as raw material for selection;

some characters formerly neutral would then effect survival. Thus the accumulation of small variations in the same direction could proceed far beyond the original range."

So selection has its own importance in evaluating better types, and it should not cease even when apparently pure lines have been achieved, as it will be realised that pure lines are more difficult than formerly contemplated.

What material to select.—Selectionists, much before the discovery of the selection effects, made a distinction regarding the material on which to practise selection. The general rule to be followed was to select in the material which exhibited diversity. Little distinction was made regarding the kind of diversity—genetic or environmental. Today we know that selection in a material showing environmental fluctuation has little effect, and it is here that Darwin could not make a distinction. According to him the kind of diversity did not matter. The material most likely to respond to selection is the one which has sufficient genetic variability or genetic variance. The real difficulty arises in estimating the genetic variance and thus deciding upon the kind of meterial on which to practise selection. The nature of the difficulty is the trouble of separating the genetic variance from the environmental variance. It is only very recently that the difficulty has been overcome to some extent. Otherwise before it, the usual method of estimating variability used to be in trying the material in a large scale with a view to look to the diversity. The material which was found to be greatly variable was the one generally concentrated upon. Regarding the stage at which selection is to cease and attention diverted to other material, the considerations which governed were either the isolation of the desired type, or separating the material into its components botanically. Thus most of the former methods of selection yielded no more than a list of plant breeding material available in a particular agricultural crop. Hutchison and Panse, in an article entitled " Studies in Plant Breeding, Technique 2, the design of field tests of plant breeding material" in the Indian Journal of Agricultural Science, have described a useful method of estimating genetic variance under the subhead

"compact family blocks", where families together with its progenies are tried in the replicated randomised blocks. The different families are first assigned at random in each replication, and then the progenies of the different families are assigned in a random manner in each family plot. By this arrangement the environmental contribution to "within family error variance" is reduced to a minimum. This, together with the random arrangement of the family plots, makes the comparison of the within family error variances a particularly useful method of comparing the relative magnitude of the genetic variance within the progenies of different families. The variance due to environmental causes cannot be estimated by it, but is distributed at random between families; and significant differences in the error variances may be assumed to be due to differences in the genetic component only. The variances for heterogeneity can be tested by Steven's formula (appendix to a paper by Fabergé, 1936).

Let $s_1^2 - s_r^2, sk^2$ be the set of variances which it is desired to test for heterogeneity each with $n_1 - 1 - n_r - 1, n_k - 1$ degrees of freedom.

$$\text{Also let} \quad s^2 = \frac{\sum_{r=1}^{k} \left\{ (n_r - 1) s_r^2 \right\}}{\sum^{k} \left(n_r - 1 \right)}$$

Then Stevens has shown that

$$\tfrac{1}{2}s^4 \sum_{r=1}^{k} \left\{ (n_r - 1)(s_r^2 - s^2)^2 \right\}$$

is distributed approximately as χ^2 with $k-1$ degrees of freedom. S^2 is determined by dividing the total sum of squares for error by the total degrees of freedom of the different families of the material. The s^2 is subtracted in turn from each family's mean square for error, and the differences squared and multiplied by its own degrees of freedom. The sum of these products divided by $2s^4$ is the value of χ (with

degrees of freedom equal to one less than the number of families under consideration) for heterogeneity in variance. The value of χ^2 can then be tested against P, and any value of χ^2 greater than ·05 level of probability is regarded as heterogeneous and can respond to selection.

The difficulty equally arises as to when to stop selection and proceed to bulking the material for field trials. The most satisfactory answer is when the genetic variance has fallen low, *i. e.* when it shows homogeneity on the test described above. The general consideration for selection is that it should be practised in families showing high mean and high genetic variance. The families which have high means and low genetic variance are to be bulked, and the families with low mean and low genetic variance are to be rejected.

Difficulties in selection.—Selection necessarily involves comparison. In agricultural crops environment plays a big role, so much so, that most of the differences are ascribable to environmental causes, especially when the site for experimentation is very heterogeneous. It is therefore absolutely essential that the site for field experimentation be uniform and of average fertility. Even with such a safeguard the comparatively minor differences within the experimental site are not rare. There may be a fertility gradient running in a particular direction, or some parts of the site may be a little more fertile than the others. Faced with such a set of circumstances, if the comparisons are made on the results obtained by just sowing the plots side by side, several questions of fundamental inportance are left unanswered. The questions are whether the results obtained are not those obtainable in the ordinary course, or whether the results obtained are such as to merit selection. Modern methods of replication and randomizations are evolved to overcome such difficulties. Not only the minor variations in the soil fertility are averaged out between the different replicates, but also the soil variations within a replicate are distributed at random between the different treatments. By virtue of such a design, comparisons are possible, free of the major differences contributed by errors of random sampling and

environment especially for those characters which are influenced by it, such as yield and other quantitative characters. The nature and number of samples present their own difficulties, namely cultivation or irrigation effects on the different samples (treatments), resulting in the use of larger plots. Otherwise special inconvenience is to be encountered, and necessarily involving a large area under experimentation. This means an increase in soil heterogeneity, thereby increasing unnecessarily the error ascribable to "errors of random sampling" as it is called. This has led to the evolution of designs named as split plot, factorial and quasifactorial In all such designs however the fair play of the laws of chance and replication is fundamental.

Another difficulty which arises is that of a standard against which the major comparisons are to be made. The difficulty is overcome by inclusion of the local variety: and anything which is better than 'local' is worthy of selection.

Selection methods.—In nature two kinds of processes are met in plants by which seed set and subsequently propagate. When seed setting is effected by the reproductive elements of the same plant, they are said to be self-fertilized plants, but when effected by the reproductive elements of the other they are classified as cross-fertilized plants. In a population of crop plants exposed to natural cross-pollination by the various agencies, namely wind and insects, certain amount of cross-pollination takes place even in self-fertilized plants. Since the reproductive elements, pollen and ovule, are known to carry factors which determine the behaviour of a plant to a large extent, selection methods with a view to evolve economic varieties have got to be different with different classes of plants. The cases where self or cross-fertilization is the rule will not be considered here, and will form the basis of a separate communication. Only those cases will be considered where self-fertilization is the main process but cross-fertilization can also be effective; and those where cross-fertilization being the main process self-fertilization can also be tolerated, *i.e.* partially self- or cross fertilized plants.

Self-fertilized plants.—The plants belonging to this group are at an advantage in that introduction of

foreign factors in their germinal constitution is the least. And, since they are compatible with their own pollen, any foreign factors are easily eliminated as recessives, as will be clear from the following consideration of selfing of a heterozygote where the small letter represents the foreign factor.

Aa $\times$ Aa.
AA, Aa, aA, aa.

All the plants carrying 'a' can be discarded, and AA the one which is wanted can be multiplied and will breed true.

With a type heterozygous for a large number of factors several generations are required to purify the type. Assuming that a large number of factors are concerned in the expression of quantitative character such as yield, it is aimed to isolate by selection a progeny which has the maximum aggregation of the yield factors.

The general procedure is to collect large amounts of material from a tract where improvement is desired to be effected. The material is grown under uniform conditions and selfed as it is called: that is to say it is made sure that the further seed setting is by the reproductive elements of the same plant. The produce or the character under study is compared amongst itself and the poor performers separated. With the progeny of the better performing material further comparisons are made taking into consideration the part played by the environment in influencing the results. (A replicated progeny row method of Hutchinson and Panse is most useful at this stage). The material in this way, after several progeny trials, is consistently reduced in bulk. When the material has been considerably reduced by selection, the better performing progenies are bulked and tested against the local standard in a small bulk trial, and that which proves superior is taken further and retested on large scale tests (varietal trials), and finally multiplied and distributed. The other part is tested for heterogeneity in the compact family blocks to decide further line of action. If heterogeneity is found it is further selected, and if heterogeneity is nil the attention is diverted to another material. Throughout this programme of selection an eye is kept on the behaviour of

mean values of the different progenies under test, and only those progenies are selected which have their values higher than the mean of the family they belong to By this process of selection generally known as 'Pure line selection' the fittest type is isolated. Recent researches of Hutchinson, Apte, and Pugh (1938) in Malvi *jowar* have shown that the fittest population is not of the fittest type but a mixture of several types made fittest by the process of natural selection. In the light of this finding the isolation of the fittest type from a population will not answer the purpose, but the evolution of a mixture of types keeping pace with the climatic and other conditions of a tract. Such an evolution of a mixture is not an easy task and the breeder has to have ready at hand several types to fall back upon, should his best one fail to succeed.

Cross-fertilized plants.—Since new factors are always introduced in every generation the amount of heterozygosity expected is considerable. There are several processes in vogue in effecting improvement in such a crop. The one of common use is in-breeding and thereby elimination of recessives, as in the previous case of self-fertilized plants. The major trouble which one has to face by in-breeding, in the case of cross-fertilized plants, is the loss of vigour. But it can be avoided to a great extent by careful selection of strains in which in-breeding can be practised without much loss of vigour. East and Jones have practised in-breeding without any appreciable loss of vigour in maize for 25 generations. In strains where loss of vigour is considerable, it can be encountered by taking resort to controlled pollinations, using strains which have been established as pure Generally what is done is that several strains which are evolved free of deleterious recessives are allowed to cross amongst themselves to ensure the hybrid vigour lost by continued in-breeding. Strains evolved by the procees of in-breeding are also said to gain in vigour when they are pollinated within themselves.

The alternative method of selection in the cross-pollinated crops is to select for one parent, either the male or the female, (generally the female), and thereby conserve the largest number of economic genes in a type.

Mass Selection.—It is the oldest method known to agriculturists in effecting improvement in the crop plants. It is applicable in both kinds of plants: self and cross-fertilized. The method consists in the selection of a few individuals in each generation possessing the desired characters and in using them in raising the next crop. It was however observed that the improvement thus effected was only temporary, as, when the selection was stopped, the crop again reverted back to its original nature within a few generations In some cases, namely the Leaming variety of corn, the improvement was however permanent. Recent work on mass selection though it has failed to remove the limitation of the method has nevertheless supplied an explanation of the principles involved. The explanation calls for technical details. Suffice it to say that it has to do with numerous genetic factors which control the expression of various characters in inheritance and the action of modifying factors on them.

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A STUDY OF SOME PASTURE GRASSES AT THE ALLAHABAD AGRICULTURAL INSTITUTE

BY

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INTRODUCTION.

The success of the dairy industry in this country, depends a great deal on the availability of good pasture grasses, as pastures throughout the world supply the cheapest and most economical food for live-stock during the growing season, and also permit the utilization of land too poor or rough to be used for other farm crops. The amount of food available for the animals in this country is not enough and many of them are not properly fed. So long as this goes on, the efforts being made now to improve the quality of live-stock by distribution of pedigreed bulls will not be of much profit. Hence it is more or less imperative that we should increase the production of animal feed in this country.

The farmers of this country have made practically no effort to increase the production capacity of their pastures. They just depend on the prevailing conditions of the soil and the climate. No attempt was made to study seriously the production capacity or the carrying power of a pasture.

Knowing this state of things the Agronomy section of the Institute was asked by the Principal to make a study of some of the indigenous pasture grasses of the farm. Accordingly an experiment was designed to test out three of the most common pasture grasses on this farm. These are : (1) *doob* (Cynodon dactylon), (2) *banderia* or *anjan* (Pennisetum cenchroides) and (3) *janai* (Andropogon pertusus),

Laying out the Experiment.

Due to the limitation of staff and some other facilities it was not possible to study certain agronomic characters of these grasses, such as : (1) their palatability and digestibility, (2) the effect of maturity on their composition, (3) the effect of frequent cutting or grazing on the total yield of these grasses, (4) the effect of manuring, etc. The experiment, however, was designed to test only two factors which we at the time considered important in connection with pasture grasses and the pasture problem in this country. These are (1) yield per acre of each of these grasses, (2) the effect of cultivation on the yield of the grasses. So the experiment is a two factor one, and was designed according to the present-day statistical methods of field experiments.

The type of lay-out was a randomized block lay-out. The dimensions of plots and total area were as follows :

The size of each plot was $12' \times 60'$. The size of a block was $72' \times 60'$. There were altogether six replications. The total size of the area of the experiment was therefore $72' \times 60' \times 6$ or 25,920 sq. ft. The rows were 18″ apart. So there were 8 rows in each plot. The six blocks were arranged in two rows, so that the dimensions of the lay-out in the field was $216' \times 120'$.

The above grasses were planted in the monsoon season of 1937. Rooted slips were used in all cases for planting and were planted at a distance of about 9 inches apart on the side of a furrow. The number of rooted slips used per row was therefore 80, or 960 per plot.

The grasses were irrigated occasionally as needed, and three of the plots in each block were given frequent cultivation with a Planet Junior cultivator while the other three plots were not. No other treatment was given, except occasional removal of the weeds that might smother the grasses. The grasses were harvested with sickle when they were in full bloom. Each plot was harvested separately and its produce was weighed and recorded. Thus in the course of one year many of the plots yielded 6 cuttings altogether.

Results and Discussion.

It seems unnecessary to give the detailed data here; therefore, the total yield of six cuttings of each plot is given in the following table.

Table I.—Total yield of 6 cuttings, in maunds (82 lbs.)

Treatments.		Blocks.						Total.	
	Grasses ..	I	II	III	IV	V	VI	of each grass.	of each treatment.
Cultivated.	Doob ..	10·5	9·0	10·0	9·8	11·0	9·6	59·9	
	Banderia	9·6	18·4	16·3	12·8	11·0	13·9	82·0	
	Janai .	16·2	11·7	16·1	13·9	13·1	14·2	85·2	227·1
Uncultivated.	Doob ..	10·2	9·9	13·2	11·0	12·1	11·7	68·1	
	Banderia..	15·5	15·1	15·5	11·5	13·3	15·4	86·3	
	Janai	11·3	11·8	14·9	17·2	15·2	17·6	88·0	242·4
	Total .	73·3	75·9	86·0	76·2	75·7	82·4	469·5	

The above data are the weights of green grass. So it was thought that since the important part of the fodder is the dry matter contained in it, a very crude method of estimating it was adopted. This consisted in weighing portions of green grass from each plot and then drying them in the sun. After a couple of days, these dried grasses were weighed again. The percentage of moisture lost in each case was determined. The data obtained showed that there was practically no difference in the percentage of dry matter in each of the three grasses. We therefore concluded that the statistical analysis of the weights of green grasses would give us valid conclusions.

The result of the analysis is as shown below.

Table II.—Analysis of variance of the above data.

Due to.	Degrees of freedom.	Sum of squares.	Mean square.	Z	Level of significance.
Blocks ..	5	18·968	3·793	·0317	No significance.
Grasses ..	2	103·090	51·545	1·2730	1 % significance.
Treatment .	1	6·666	6·666	·2504	No significance.
Error ..	27	109·096	4·040		

We therefore arrive at the following conclusions.

Uncultivated grasses	Cultivated	Significant difference
242·4	227·1	23·7

Janai	Banderia	Doob	Significant difference
173·2	168·3	121·8	20

It was therefore found that there was no statistical or significant difference in the yield of the cultivated and the uncultivated grasses.

Amongst the three grasses, *janai* and *banderia* have given almost the same yield. *Doob* however is very much inferior in yield to any of the other two. The fact that *janai* and *banderia* are more liked by cattle and also coupled with the fact that these give greater yields than other common monsoon pasture grasses such as *doob*, makes these grasses much more valuable as pasture grasses than other similar indigenous grasses in this area. However, *doob* is much more liked by horses, and is also a very useful lawn grass all over this country, and for that reason has a place in the agriculture of the country.

In order that one may get a better idea of the produce obtained per acre in the course of one year from these grasses, the yield data were converted to maunds per acre which are as given below. The grasses were planted in

August, 1937 and the sixth cutting was completed by the end of August, 1938.

Name of grasses		Without Cultivation Yield in Mds. per acre	With Cultivation Yield in mds. per acre
Janai	..	887	852
Banderia	..	863	826
Doob	..	681	605

These yields seem somewhat high. But this is to be expected as the grasses were irrigated with sullage water. The grasses however yielded profusely during the rainy season even without any irrigation, but less so during other seasons of the year.

This same experiment was continued in the second year but without irrigation. We were able in the course of the year to get only two cuttings (compare this with 6 cuttings under irrigation). The yield data of the experiment are as given below.

Table III.—Showing the yield in maunds of the three Pasture grasses in 2 cuttings, without irrigation.

Treatment.		Block						Total.
	Grasses. ..	I.	II.	III.	IV.	V.	VI.	
Cultivated	Doob	2·0	3·3	3·4	2·8	3·7	4·1	19·3
	Banderia ..	3·5	3·2	6·6	3·9	4·0	3·9	25·1
	Janai ..	6·7	4·8	5·2	5·5	6·3	7·1	35·6
Uncultivated	Doob ..	2·4	3·1	4·2	2·0	2·3	5·3	19·3
	Banderia ..	3·6	5·3	6·0	2·8	3·4	3·8	24·9
	Janai ..	4·6	4·3	5·5	4·6	8·0	5·8	32·8

The results of the analysis of the above data is as shown below.

Table IV.—Analysis of the above data:—

Due to.	D. F.	S. S.	Mean square.	Z.	Level of significance.
Block.. ..	5	11·06	2·21	·3627	No significance.
Grasses ..	2	37 68	18·84	1·4342	1 % significance.
Treatments ..	1	·25	·25	·4709	No significance.
Error ..	27	28·88	1·07	..	

Thus the conclusion arrived at is as follows :—

	Jaini.	Banderia.	Doob.	Sig. difference.
Yield per grass.. ..	60·4	50·0	38·6	10
Yield of grasses in maunds per acre.	302·0	250·0	193·0	50

	Cultivated grasses.	Uncultivated grasses.	Sig. difference.
Yield per treatment ..	80·0	77 0	13 0
Yield per acre	266·7	256·7	43·3

Conclusion

This experiment showed that the grasses which were cultivated did not show any superiority over those that were not cultivated. Therefore the only care that these grasses need is the occasional removal of weeds and other grasses that do not have any fodder value, and which also may smother the pasture grasses. The experiment also showed that *janai* and *banderia* are superior to *doob* in respect of yield whether they are grown with irrigation or without it, and that *janai* is somewhat better in yield to *banderia*. when grown without irrigation. However *janai* does not seem to be superior to *banderia* when these two are grown with irrigation.

Acknowledgments

I am indebted to the students of my class for laying out the experiment in the field and also for analysing the data thus made available to them. My thanks are also due to Mr. B. H. Pawar, the fieldman, for recording the data.

THE PRINCIPLES OF MAKING MARMALADE

By

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The name marmalade is generally applied to that jellied fruit product which contains suspended within it all or part of the fruit pulp or sliced peels. Marmalades may be divided into two classes according to their texture.

1. *A true marmalade:*—It is a jelly-like substance in which the slices of rind are uniformly distributed and suspended throughout a fruit jelly without losing their shape. A good marmalade is clear, transparent, sparkling, has attractive colour, possesses the characteristic flavour of the fruit or fruits from which it is made and sets like a good jelly.

True marmalades are prepared from only those fruits which are rich in acid and pectin contents and have pronounced flavour. Citrus fruits are preferably used for manufacturing the best kind of marmalades because of their rich flavour, acid and pectin content. This kind of marmalade is very much liked because of its attractive appearance, rich brilliant colour and excellent texture.

2. *Second class marmalade*:—It is that preserved fruit product which may or may not have a jelly-like consistency, contains fruit pulp, and may contain the rind slices suspended in a jellied product or mixed in a jam-like product, depending on the kind of fruits used. It has the consistency of jam, preserve, or fruit butter, rather than of a jelly.

Such marmalades are usually cloudy If cooked very carefully they may become clear, but generally they never become sparkling or transparent. They attain jelly-like consistency if prepared from fruits rich in acid and pectin content otherwise they remain like a thick jam. This kind of marmalade is usually prepared from pulpy fruits, preferably those which contain pectin. There is little or no demand for this kind of marmalade because of its dull colour and unattractive appearance.

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Kinds of Marmalade

1. *Bitter marmalade*:—This kind of marmalade is liked by English and Scotch people. Therefore in these two countries marmalades are manufactured from bitter and sour varieties of oranges. Bitter marmalade can be prepared from several different kinds of citrus fruits such as lemons, khatta, jambheri lime, grapefruit, pummelo and kumquats.

2. *Sweet marmalade*:—Sweet marmalades are usually preferred by American people. Therefore in that country marmalades are prepared from table varieties of oranges. Ordinarily so called sweet orange marmalades are not pure orange marmalades, because most oranges are usually deficient in acid and pectin or both in fully ripe stage. This deficiency is made good by lemons or other citrus fruits rich in these ingredients.

Indian people also prefer sweet marmalade to bitter marmalade. Therefore for a local market, marmalades in India should be manufactured from oranges or sweet citrus fruits. As it has already been mentioned that oranges alone, being deficient in acid and pectin, are no good for making excellent marmalade, it is therefore necessary to add other fruits such as lemon, grapefruit, khatta, etc. But the addition of such fruits would impart bitter flavour to the marmalade. This does not mean that such fruits cannot be used for making sweet marmalade. Sweet marmalade can be made from sweet citrus fruits, but they can also be made from bitter fruits as well. The rind of bitter fruits is peeled off and the pulp cooked, and separated. The rind is sliced and boiled for two or three times in a large quantity of fresh water, discarding water every time after boiling for a short time. This would remove all the bitterness, and the cooked peels may then be added with the rest of the pulp. If the pulp is also excessively bitter, as it is in the case of certain citrus fruits, the juice of the fruit may be squeezed from the pulp and the pulp cooked in one or two changes of fresh water to remove the bitterness

Marmalade is defined as a jelly-like substance in which the shreds are suspended. Marmalades can only be prepared

from fruits which are rich in acid and pectin. Therefore all those principles which govern the manufacturing of jelly hold good in the case of marmalade with the exception that the slices of rind are separately prepared, cooked, and added to the jelly, just before the end point. Therefore the readers are referred to a previous article on the principles of making jelly, in order to manufacture excellent marmalade.

The Process of Making Marmalade

In the principles of making marmalade it has been mentioned that there are two kinds of marmalade: (i) a true marmalade, and (ii) a second class marmalade, which essentially differ in their constituents and texture. The methods involved in manufacturing these marmalades are quite different. A method of manufacturing true marmalade, in its essential feature, has the same procedure as the method of making jelly, with the exception that prepared slices of rind are added to the jelly while it is being cooked just before the end point. On the other hand a method of making second class marmalade has almost the same procedure as the method of making jam, with the exception that second class marmalade, may sometimes contain slices of rind. The methods of making jelly and jam had already elaborately been discussed. Therefore the methods of making marmalades will not be discussed elaborately, but some fundamental features will receive attention.

The process of making true marmalade involves the following steps (in their chronological order).

1. Selection of fruit
2. Preparation of fruit
3. Extraction of juice
4. Straining and filtration of juice
5. Testing juice for acid and pectin
6. Preparation of rind slices

7. (*a*) Boiling
   (*b*) Sugar requirement
   (*c*) Addition of sugar
   (*d*) Removal of scum
   (*e*) Addition of slices of rind
8. End point
9. Filling
10. (*a*) Flavouring
    (*b*) Cooling
    (*c*) Filling and sealing
    (*d*) Labeling and storing

Selection of Fruit :—True marmalade is never prepared from vegetables. It is prepared from those fruits which are pulpy and are rich in acid and pectin and possess pronounced flavour. The best kind of marmalade is preferably made from citrus fruits. Almost all citrus fruits can be used for making marmalade provided the deficiency of acid and pectin is made up in cases of those fruits which are either deficient or lack these ingredients. The fruits must also be well ripe, richly coloured and unblemished.

Preparation of fruit: Marmalades may be made from one fruit or from a combination of fruits, although a pure marmalade should be made from one fruit. A great percentage of marmalades in the market are not pure, but a mixture of two or more fruits. A so called orange marmalade contains 30 to 50 per cent lemon because pure orange marm;alade can hardly be prepared due to lack of pectin and, n certain cases, acid. Therefore while preparing fruits for marmalade, the percentage of the major fruit should be the maximum and the percentage of the minor fruit just sufficient to give the adequate test for acid and pectin content to enable the juice to jell. Well-ripened fruits are sorted out, and the blemished parts if any are cut off and discarded. The fruits are scrubbed and washed to remove dirt, and drained. The rind of richly coloured and smooth

fruits is peeled off and saved for adding into the marmalades. The pulp of these fruits and the rest of the fruits are cut into small pieces about half an inch thick.

If bitter fruits are used for making marmalades, and if bitter marmalade is not desired, either the whole fruits are cut, boiling in large quantity of water and which is drained and discarded to remove the bitterness; or all the fruits are peeled off and the peel is cooked in several changes of water to remove the bitterness, before it is added to the pulp.

Extraction of juice:—The addition of water for the extraction of juice depends on the hardness, stage of ripening, acid and pectin content, and the juiciness of the fruit. More water should be added if the fruit is harder, green, rich in acid and pectin content, and has less juice. The purpose of extraction of juice is to extract the maximum amount of acid and pectin from the cell-walls of the fruits. Better extraction will be effective only if the fruit is cooked into a pulp. The harder and green fruit would require longer cooking, but prolonged cooking is detrimental to the quality of marmalade. In order to reduce the length of cooking a little carbonate of soda may be added while the fruit is boiling, which has the softening properties on the cell wall, and therefore hastens extraction of pectin from the cell-wall of the fruit.

In most of the citrus fruits the amount of water added for the extraction of juice is three to four times the volume of fruit. The fruit is boiled on brisk fire and in a covered kettle until the fruit is cooked into a pulp which generally takes three-fourths to one hour and for some fruits a little longer. The amount of water requirement and the length of cooking is given in the following table.

Table showing the amount of Water and Length of Cooking

Name of fruits	Amount of fruit by weight	Amount of water by weight	Length of cooking
Sour oranges and lemons 50% each	4 lbs.	12 lbs.	40-50 minutes
Sour oranges and lemons 75% and 25%	4 ,,	12 ,,	30-40 ,,
Grapefruit	4 ,,	12 ,,	60-75 ,,
Pummelo	4 ,,	12 ,,	60 75 ,,
Lemon	4 ,,	12 ,,	50-60 ,,
Khatta	4 ,,	16 ,,	75-90 ,,
Kumquat	4 ,,	12 ,,	30-40 ,,
Khata 25%, Sour orange 75% ..	4 ,,	12 ,,	45-60 ,,
Khatta 25%, Grapefruit 75% ..	4 ,,	16 ,,	60-75 ,,
Khatta 25%. pummelo 75% ..	4 ,,	16 ,,	60-75 ,,
Sweet orange 75%, khatta 25% ..	4 ,,	12 16 lbs.	60-75 ,,
Kaghzi lime 25%, sour ora ge 75%	4 ,,	12 16 ,,	50-60 ,,
Kaghzi lime 50%, sweet orange 50%	4 ,,	12-16 ,,	50-60 ,,

When the fruits are cooked to a pulp, the mixture is strained through a thick cloth bag and the pulp is pressed in a wooden rack to squeeze out as much juice as possible.

Filtration :—In order to get a clear and sparkling marmalade, effort should be made to remove as much pulp as possible. Some pulp does come out even through a thick cloth bag during the process of pressing with a wooden rack. The juice may be cleared by allowing it to stand in shallow vessels over night: the pulp settles down and the clear juice is drained off carefully. This juice may further be strained through felt bags to get good clear juice.

Testing acid and pectin content of juice:—All juice should be tested for acid and pectin before proceeding to make marmalade The methods of testing acid and pectin are described in the article on jelly making. Balling test is more satisfactory for turning out marmalade of a given standard. Cruess suggest that when lemons and oranges are used, the juice should test about 6° Balling at 15·5 C (60° F)[9] This Balling may be corrected by adding water if the Balling is about 6°, or by concentrating the juice if the Balling is below 6°.

Preparation of rind slices :—The attractive appearanec of marmalade depends upon the slices, because in the transparent jelly even a little blemished spot is reflected and magnified. Therefore fruits, the peels of which are usually added to the marmalade, such as lemon, oranges and grapefruit and *khatta* should be smooth, thin-skinned and free from all blemishes.

The peels are prepared in three ways :

(1) The stem and the blossom ends of fruits are pared off and one inch wide slices are cut from stem end to the blossom end, saving the pulp for extracting juice for marmalade. These slices are then cut cross-wise into very thin slices about 1/32 of an inch thick. The slices are cut with a shredder. For household purposes or for small industries slices may be cut with a knife. The disadvantage of cutting with hand is that the slices are not uniformly cut. There are now small, ordinary and cheap shredders which may economically be used for small industries.

(2) The second way of cutting and preparing slices consists in cutting the whole fruit very finely with a machine. The fruit is boiled for the extraction of juice. When the fruit is thoroughly cooked, it is poured out into screens, and the adhering white pulp is washed off under a vigorous jet of water from the slices, leaving the slices in more or less the same form as cooked slices prepared in the first method.

(3) The third method which is used in large factories where juice and slices are not prepared separately, is one

in which the whole fruit is finely chopped in a large machine and the whole mixture is cooked in sugar into a thick mass in the same way as jam. The marmalade prepared in this way is cloudy and of jam-like rather than jelly-like consistency. The marmalade prepared in this way is bitter and has a pronounced flavour because nothing is lost during cooking.

The peels obtained from the last two methods are automatically cooked, but peels from the first method required cooking separately. While the fruit for the extraction of juice is being cooked, the peels are shredded and boiled in large quantities of water for about 10 minutes. The water is drained off and fresh water is added. It is parboiled again and water is drained off to remove the bitterness. There is a general tendency to let the peels simmer on one side of a slow fire while the fruit for extracting juice is being cooked on brisk fire. It has been experienced that if the peels are allowed to simmer, they become very tough.

The slices can be softened either by prolonged boiling, which is not desirable, or by heating with water in an autoclave under 10-15 lbs. pressure. The best method of softening peels is to cook them in a dilute solution of sodium carbonate or ammonium hydroxide.

The best way of preparing slices is the first one because it gives very attractive appearance to the marmalade. The second method may be preferred where a large quantity of marmalade is turned out daily.

Boiling:—The process of boiling is the same as described for jelly. A desired amount of juice is taken and when the juice begins to boil, the required amount of sugar and a small amount of salt is added and is dissolved by stirring. Stirring is stopped for a few minutes when organic matters are precipitated by heat and rise to the surface in a form of thick layer which should be carefully removed by a flat spoon. The juice should be strained at this stage to remove foreign matters which are either found in sugar, no matter how pure it is, or formed by precipitation of organic matter. If these are not removed, they show up as black specks in a clear marmalade and give it a dull appearance. The juice is put back on the fire and allowed

to boil rapidly. Just before the end point, 2 to 4 ounces of cooked slices of peels are added to every 3 lbs. of juice taken, and boiling is continued until the end point is reached. The end point is determined in the same way as described for jelly.

The amount of sugar required for marmalades is generally greater than for jelly because a marmalade stock which is prepared from citrus fruits is high in both acid and pectin and low in sugar content. The temperature at which marmalades give jelly test is also slightly lower than for most jellies, because of high percentages of acid and pectin of juice from which the marmalades are prepared.

Marmalades give a good jelly test between 218° to 221°F depending on the richness of juice in acid and pectin.

From the author's experience the following amount, of sugar, and end point have given the maximum yield :

Name of fruit.	Amount of juice in lbs.	Amount of sugar in lbs.	End point Temp. in F.	Yield in lbs.
Sweet orange marmalade ..	3	3	220	3½
Sour orange marmalade .	3	3¼	219	3½
Grapefruit marmalade ..	3	3½	219	3¾
Pummelo marmalade ..	3	3½	220	3½
Lemon marmalade ..	3	4	218	4
Khatta marmalade ..	3	4	218	4
Kumquat marmalade ..	3	3½	219	3½
Khatta 25 %, sour orange 75 %	3	3¾	219	3½
Khatta 25 %, grapefruit 75 %	3	3½	219	3¾
Khatta 25 %, pummelo 75 % ..	3	3½	220	3½
Kaghzi lime 25 %, sour orange 75 %	3	2½	219	3½
Khatta 25 %, sweet orange 75 %	3	3	220	3½
Kaghzi lime 50 %, sweet orange 53 %	3	3	220	3½

Flavouring and Filling:—One of the greatest defects in marmalades is that during extraction of juices and boiling the juices to jelling point, a great deal of oil and flavour from the peels as well as from the finished product are removed so much so, that in most cases it is hard to tell by taste the fruit or fruits from which the marmalades are prepared. In order to overcome this difficulty and produce marmalades having a distinct pleasing flavour a small amount of oil or extract of orange, lemon, grapefruit or other citrus fruits is added and thoroughly mixed with the marmalade after the boiling has been completed

Filling:—Unlike jelly, marmalade is not poured boiling hot in the final containers. The peels being lighter remain floating on the surface, leaving a clear jelly at the bottom of the containers which is highly undesirable from the marketing point of view as it looks more like a jelly rather than a marmalade. In order to avoid this defect, the marmalade is allowed to stand in a kettle to cool partially long enough for the shreds of peels to distribute themselves uniformly throughout the jellied juice and also to permit absorption of sugar by the peels from the surrounding syrup. If the marmalade is poured into clean sterilized jars at this stage the peels will remain uniformly distributed and suspended in the jellied juice, which gives a very attractive appearance.

If marmalade by any chance is not allowed to become sufficiently cold at the time of pouring in the jars, the peels will remain floating on the surface which should be pushed down and uniformly distributed by means of a spoon when it becomes sufficiently cool. Care on the other hand should also be taken not to cool down the marmalade too much; otherwise while pouring it in the jars, small air bubbles will be formed that will give flocculent appearance to the marmalade.

Marmalades should be poured in hot sterilized jars pasteurized and scaled according to the same method as described for jelly and the same care should be taken in labelling and storing.

METHOD FOR MAKING SECOND CLASS MARMALADE

The fruit is selected and washed in the same way as described in the previous method. The rind is peeled off, cut into thin slices and parboiled three times in a large quantity of fresh water to remove the bitterness if bitter marmalade is not desired. The pulp is then cut into small pieces. The sliced pulp and parboiled peels are combined and to each volume of this prepared fruit, two or three times as much water is added and cooked rapidly for about 40 to 50 minutes. When the fruit is thoroughly cooked, the mixture is then weighed and to it an equal amount of sugar by weight and a small amount of salt is added The fruit is boiled very rapidly until it becomes fairly thick or gives a jelly test. The mixture is allowed to stand until it becomes cool enough to prevent the slices from floating. The marmalade is poured into sterilized jars and sealed.

In very large factories where bitter marmalade is made, the whole fruit is chopped finely in a machine driven by power. To each pound of fruit are added two or three pounds of water and an equal amount of sugar, and the whole mixture is cooked to a thick mass. The marmalades prepared according to the above two methods are dicidedly superior in flavour, because the length of cooking is diminished greatly but marmalades of this kind are usually bitter, cloudy and have jam-like rather than jelly-like consistency.

GOVERNMENT AGENCIES OF AGRICULTURAL IMPROVEMENT IN INDIA

There are now in India twenty-two agricultural institutes and laboratories concerned with the improvement of crop production, about three hundred experimental and demonstration farms, a teaching and research staff of eight hundred officers and assistants and nearly two thousand officials engaged in the introduction of the successful results of research into general agricultural practice.

THE BILANDA FARM

BY

BISHAN MAN SINGH

Fatehpur, U. P.

It was in the late nineties that my father, the late Rai Ishwar Sahai Bahadur, started cattle breeding in his Habibpur Farm with a dozen good *desi* (country or local) cows and a Hissar bull which he had imported from the Punjab. When the herd began to grow he felt the necessity of cheap fodder and regular grazing ground. In order to provide these he utilised *usar* (alkali) land. About the year 1903 he selected a fairly big blot of *usar* land, about one square mile in area, dotted here and there with a few fields of very poor soil in his village Bilanda.

He proceeded with the reclamation of the *usar* land very cautiously; as no help, technical or otherwise, was available on the subject at that time. At first he collected *babul* (*Acacia arabica*) seeds and sowed them all over the area and stopped indiscriminate grazing of the cattle over it. By his persistent and untiring efforts extending over a period of 10 years he was able to grow a beautiful *babul* forest with plenty of grass over the *usar* land, which was in the beginning mostly barren or at places had '*jharberi*' (*Zizyphus rotundifolia*) shrubs, *kans* (*Saccharum spontaneum*) grass and *madar* (*Calatropis gigantea*) plants. But the mere protection from the ravages of cattle rapidly extended the growth of *kans* and kindred grasses on the barren land, which in itself became a difficult problem later on when we tried to grow cereals over the reclaimed area.

I joined my father in this work in the year 1916 after leaving college. Though this process of reclaming *usar* land by means of planting *babul* trees was a complete success so far as the question of fodder and of grazing ground was concerned, yet it required a very long time. Hence we tried various other

methods to improve our unproductive land in a comparatively short period. In some of these we were successful and in others we were not.

By the year 1930 the reclaimed land was considerably improved and we were encouraged to try to grow cereals on this land. A plot of 100 *bighas* (a bigha=3/5 acre) was demarcated for the purpose and the cultivation of cereals was started, but it did not do well. *Kans* grass and *jharberi* shrubs appeared to be insurmountable difficulties to be overcome and they greatly interfered with the growth of crops.

The most remarkable and rapid improvement came about in the year 1934 when I introduced an embankment system for the reclamation of *usar* land in a systematic way, and started paddy cultivation over the demarcated area after applying large quantities of farm yard compost manure to which a small quantity of slaked lime was added. It was a great success. Both *kans* and *jharberi* were successfully controlled and the yield of paddy was exceptionally high having reached 50 maunds (a maund=82 lb.) per acre on a few plots.

I observed in the Bilanda Farm another advantage of holding rain water. It is that on low lying areas *kans* and another coarse grass, that shoot up in luxuriant growth in the early part of the monsoon period, are slowly but steadily disappearing, giving place to very good quality 'ukar' grass which appears very late almost at the end of the monsoon and attains its full growth by the middle of December This grass is much relished both by cattle and horses.

In the year 1936 I observed that in most of the *jharberi* shrubs "ber" (*Zizyhus jujuba*) plants had started. The fruits were no doubt of very poor quality, but in great abundance. This fact suggested to me that these plums would grow very well on this reclaimed land. I therefore cut down some of the old trees leaving an inch of stem from the ground. When the new shoots appeared I selected the most vigorous ones and removed the rest. On these good shoots I put on the buds of good quality *ber* plants. I have now about 200 plants of these grafted *ber* plants. The fruits are just as

good as of those from which the buds had been obtained. They begin to fruit in the second year after grafting.

In 1937 I started guava plantation on a commercial scale and now I have over 500 plants of the same.

Last year I planted about 60 graft and 40 seed mangoes, and so far they are doing very well.

From the year 1917 to 1937 we used to sell *babul* trees worth Rs. 500 on an average every year, and in 1938 I sold all the big *babul* trees for Rs. 13,750. I hope the existing *babul* trees will now develope more rapidly and will fetch an equal amount of money after 10 or 15 years.

Now almost the whole area of the farm is sufficiently developed for successfully growing rice and other cereals and portions of it are quite fit for growing even sugar cane. This year the second crop of gram which was sown broadcast after harvesting the paddy crop is as good as any grown on monsoon fallow fields.

With so much cultivation and plantation the farm provided fodder and grazing ground for a herd of 100 head of cattle.

EDITORIAL

(*Continued from page 116*)

study of linseed, cotton, barley and several other crops bids fair to produce promising results which we hope will ultimately be of great benefit to the province.

While we therefore believe that such research schemes as are of benefit to the cultivators should get all the encouragement they deserve, not only from government and public men of the country, we also believe that more careful scrutiny be made of the work that is now being done so that public money may not be used for schemes that may bring no profit to India or even to the scientific world at large. In fact we would urge Government not to wait for schemes of research to be submitted to them, but to discover problems of research and request institutions or competent research workers to take up such problems, so that the results obtained will be quickly made available to the cultivators.

THE SUGAR INDUSTRY IN THE UNITED PROVINCES*

Only about half a dozen years ago India imported the major portion of the sugar she consumed. This means that she sent to foreign countries about 15 crores of rupees, most of which went to Java. It was not believed then that we could be self-sufficient in our sugar requirements This was an outcome of the idea that India is an essentially agricultural country—"a country which could produce cotton but not cloth, could grow cane but not make sugar." This belief, in turn, arose from India's lagging behind the West in what is known as the Industrial Revolution—a complex phenomenon depending on numerous factors.

But the sugar industry is not entirely new to this country. Sugar-cane was known here in the earliest recorded times, the Indo-Gangetic plain being its first home. India in those days sent sugar-cane to the neighbouring countries. In ancient Sanskrit literature mention is made of *gud*, meaning concentrated cane juice. Sugar proper, however, was not known until much later. An authoritative and well-known Chinese encyclopædia written about the middle of the 16th century mentions that in India the art of sugar making had reached such a high standard that the Chinese Emperor Tai Tsung (627-650 A.D.) sent his men to Bihar to learn it.

Old methods.—According to old records Java, our principal supplier of sugar until recently, did not start making sugar until about 1,000 years after.

A big sugar industry flourished in India for centuries. But we stuck to old methods while the West made rapid strides in chemical and mechanical fields. The East India Company in its early days concentrated on cotton and indigo while the West Indian British planters and merchants developed a thriving sugar industry. Being more influential than the East India Company, they secured favourable tariff rates, gradually captured European markets, and were even instrumental in stifling the sugar industry in India.

*An article borrowed from the Industrial Supplement of "The *Pioneer*."

In 1836, however, the difference in the rates of duty on West and East India sugar was abolished It had its immediate repercussion in India where in Bihar, the United Provinces and Madras several sugar factories grew up and within 10 years the annual export of sugar to England reached the flattering figure of 60,000 tons. But England's adoption of free trade in 1816 caused our industry to die out as rapidly as it had grown up.

New life.—Towards the end of the last century indigo prices fell. This gave our sugar industry another impetus, but only a feeble one this time. Not until 1931-32 was a new lease of life granted to the Indian mills. At that time the Tariff Board inquiry concluded; a revenue surcharge of 25 per cent. on all import duties was established; England went off the gold standard and, finally, protection was granted to Indian sugar in April, 1932. These circumstances brought about a rapid increase in the number of our mills. The slight setback received from the dropping of prices of molasses and sugar owing to increased production and an excise duty imposed in 1934 on home produced sugar really helped the industry by checking its excessive expansion.

In 1934, too, were passed two Acts: one enabling local governments to formulate rules for fixing minimum prices of sugar-cane and regulating its purchase and the other empowering the Governor-General in Council to call for returns relating to production from owners of sugar factories. These measures were intended to stabilise the industry which showed signs of speculative boom.

By 1936-37 it became quite clear that with a good crop of sugar-cane our factories could produce more sugar than we could consume. More than Rs. 20 crores were invested in the industry. One of its effects was that it directly benefited cane growers and found employment for educated young men and other workers. The annual wage bill of the industry amounts to-day to over two crores of rupees. It was the sugar industry which was responsible for averting the agrarian revolution that threatened the United Provinces and Bihar during the first half of the thirties.

Tropical areas—The two provinces mentioned above are the most important sugar producing tracts in India, having between them about 75 per cent. of the total number of factories in the country. Ordinarily, the tropical areas, *viz.*, Bombay, Madras, Mysore, Hyderabad, where conditions similar to Java prevail, might be expected to be the principal sugar producing areas. As a fact, however, only 9 per cent. of the acreage under sugar-cane is in that area and about 90 per cent. of India's total sugar-cane is produced in the sub-tropical areas, *viz.*, the United Provinces, Bihar, the Punjab, Bengal, etc.

The only possible explanation of this apparent anomaly seems to be the comparatively lower cost of cultivation of sugar cane in the sub-tropical area owing to the fertility of the Gangetic plain This more than balances the natural advantages of the tropical area.

As has been already said, the years immediately following 1931-32 saw a rapid growth of the sugar industry in India. The rate of progress in the United Provinces will be clear from the following figures :

Year :	1931-32	'32-33	'33-34	'34 35	'35 36	'36-37	'37-38
Number of cane factories	14	33	59	65	67	68	68

The leading position of the United Provinces in the field will become apparent when it is realised that while in 1931-32 both the United Provinces and Bihar started with almost equal number of cane factories, from the next year the former had practically double the number of factories working in the latter, and in 1937-38 more than double. The number of factories in Madras is one-eighth of that in the United Provinces.

No study of the sugar industry can be complete without considering, at a fairly early stage, certain essential factors about the raw material used, namely, sugar-cane. In the United Provinces the canes grown can be divided under three classes : (1) Indian indigenous canes, (2) the imported thick or "noble" type and (3) seedling canes of Indian origin.

Improved canes.—The Indian indigenous canes are being rapidly replaced by the improved varieties which are

being produced as a result of extensive researches in cross-breeding which are being carried on at different centres. Certain varieties of the former, however, persist owing to the peculiar features of certain localities For example, the *chin* variety is found in fair quantities in the United Provinces, particularly in the Lucknow division and in the central and eastern Doab. *Chin* is poor in yield but owing to its juice quality and resistance to adverse conditions it continues to be cultivated.

In the western districts of the United Provinces are to be found *dhaulu* and *dhaul* canes, two varieties of the Sunnaballe group, though to a very small extent. These are hardy and capable of producing good *gur*.

Of the second class, namely, imported canes of the "noble" variety only very little is found in the United Provinces

In India the seedling canes are bred principally at two important breeding stations, Hebbal (Mysore) and Coimbatore. The Coimbatore canes are grown in the United Provinces in large quantities, especially the Co.—213 variety. This variety, in fact, dominates the sugar-cane areas in this province.

The chief points about Co.—213 are: vigour or tonnage, good habit and ability to grow under different conditions. It is somewhat susceptible to salinity in soil and is liable to take red rot It covers the land during the early stages of growth, thus suppressing weeds.

Another Coimbatore seedling, Co —244, is fairly extensively grown in the United Provinces occupying about 9 per cent. of the total area under cane here. Its usefulness was first discovered in the western districts where it flourished in spite of scant manure and watering. It ripens earlier than Co.—213 and is practically free from mosaic in both plant and ratoon. It is one of the best canes for poor lands

Co.—290 is about as popular in this province as Co.—244, particularly in the districts of Rohilkhand and Lucknow, the home of the *khandsari* industry. It is comparatively a soft variety giving a good extraction even from

bullock driven mills. It is a heavy yielder in this province with a juice quality better than that of Co.—213. Unfortunately it is not as good in habit and is susceptible to animal attack. It is also very popular in Natal, Louisiana and Australia.

A heavy yielder. -- Another heavy yielder is Co.—312 and an earlier ripener than Co.—213. It produces good *gur* and sugar. It is also fairly resistant to water-logging, but lodges badly, arrows profusely and is liable to both mosaic and insect pests.

Co.—313 is another recent favourite in the United Provinces owing to its earliness, high sucrose and heavy yield. Unfortunately, like Co.-312 it is susceptible to mosaic which may affect its popularity.

Co—331 is another Coimbatore variety grown in this province. In spite of its heavy yield, erect habit, quick growth, late maturity and resistance to Pyrilla, it is not a favourite with sugar factories, as it develops pith later in the season.

The United Provinces, as has been said, leads other provinces in the yield of sugar-cane. In 1937-38 the total acreage under sugar-cane was 2,181,000, being 57 per cent. of the total for India. This is slightly less than the figure for the previous year, which was 2,515,000 acres. The Punjab was next best with 554,000 acres in 1936-37 and 512,000 acres in 1937-38. The figures for Bihar are slightly lower, being 460,000 and 342,000 acres. The following table gives the total yield and yield per acre of these three provinces :

	Total yield.		Yield per acre	
	1936 37	1937-38	1936-37	1937-38
U. P.	3,802,000 tons	3,141,000 tons	3,386 lbs.	3,226 lbs.
Punjab	465,000 ,,	363,000 ,,	1,880 ,,	1,588 ,,
Bihar	493,000 ,,	356,000 ,,	2,401 ,,	2,332 ,,

The area under improved varieties of cane has increased rapidly since 1931-32. The following table gives the total area under sugar-cane and the area under improved varieties:

Year.	Total area under cane. acres.	Total area under improved variety. acres.
1931-32	3,077,000	1,170,000
1932-33	3,425,000	1,845,000
1933-34	3,422,000	2,295,000
1934-35	3,602,000	2,433,000
1935-36	4,154,000	3,056,000
1936-37	4,444,000	3,451,000
1937-38	3,815,000	3,600,000

Definite figures for 1938-39 are not yet available, the first official forecast being 3,355,000 acres as the total for India of which the United Provinces is estimated to have 1,826,000 and Bihar 468,000 acres.

From the table given above it will appear that the improved varieties which formed about 39 per cent. of the total in 1931-32, rose to about 75 per cent. in 1937-38. Comparatively, the largest percentage of area under improved canes is to be found in the United Provinces where in 1937-38, 1,932,000 acres were planted out with the improved varieties, yielding about 2,892,000 tons of *gur*, as compared with 2,263,000 acres and 3,446,000 tons in 1936-37. Owing to the planting of the improved varieties of cane, the yield per acre increased from about 12 tons in 1930-31 to 15½ tons in 1936-37.

Pre-eminent position.—Coming next to the actual production of sugar, the number of factories working in 1938-39 in India was 140 as compared to 137 in 1935-36 and 32 in 1931-32. One point to be noticed is that the two latter figures include the factories in Burma as well, whereas the figure for the last year is for India only. The

respective figures for the quantities of cane crushed and of sugar produced by cane factories are :

1931-32—1,783,000 tons and 158,581 tons ;
1935-36—9,801,000 tons and 932,100 tons ;
1936-37—11,687,000 tons and 1,111,400 tons ;
1937-38—9,916,400 tons and 930,700 tons ;
1938-39—10,250,000 tons and 950,000 tons (approx.).

Of these in 1937-38 the United Provinces claimed 68 factories (out of India's total of 136) ; 57,855,000 tons of cane crushed; and 531,300 tons of sugar produced, *i.e.*, 57 1 per cent. of the total production of India - certainly a pre-eminent position.

Besides extending the cultivation of cane and the mere quantitative increase of the net output of sugar, attention is being paid in the United Provinces to the need for improving the quality and method of production. For, although the province scores over the tropical areas in soil fertility, it has certain disadvantages compared to the southern provinces. These were succinctly summarised in the convocation address delivered at the Imperial Institute of Sugar Technology in 1937 by Mr. N. C. Mehta, I.C.S., the then Vice-Chairman of the Imperial Council of Agricultural Research. He said :

"The cane crop is subject to extreme variations of temperature and is perhaps even more subject to attacks from disease and insect pests. The crushing season in the north is, therefore, necessarily very much shorter than in the south. There is also the further handicap of heavy transport charges for having to sell 80 per cent. of the sugar produced in internal but distant markets . . . It is, therefore, necessary that the industry in these parts must develop and work at a higher pitch of technological efficiency, if it is to overcome its own inherent difficulties.

Research work on sugar technology is, therefore, being carried on in the sugar section of the Harcourt Butler Technological Institute, Cawnpore, which has been taken over by the Imperial Council of Agricultural Research to be made a central institute for sugar technology.

Having made this rapid survey of the different aspects of sugar production—from cane growing to the finished product—it now remains to examine the distribution side of sugar. This involves marketing, price control and the Government's share in fostering the industry.

India being a poor country, her *per capita* consumption of sugar is much less than that of other countries. On the average Indians consume 6·5 lbs. of sugar and 26·0 lbs. of *gur*. Compared to this the *per capita* consumption of sugar in Denmark, the highest consumer in Europe, is 123·3 lbs., and in New Zealand, the highest consumer outside Europe, it is 121 3 lbs. In India, Bombay, Bengal and the Punjab consume more sugar than the United Provinces where the *per capita* consumption in 1935-36 was 5·6 lbs., the total consumption being 131,000 tons. But the total produce in that year was 647,000 tons. In other words, this province produced about 60 per cent. of the total sugar in India and consumed only about 11 per cent.

Problem of surplus.—The problems before the industry in the United Provinces, as elsewhere, are various. They are: prevention of overproduction; evolution of an efficient and scientific system of marketing; improvement in canes and sugar technology; dissemination of necessary knowledge among the cultivators; extension of the duration of crushing season (it is felt desirable that four months at present should be extended to at least seven); development of the means of transport and reduction in its cost; popularising the use of sugar; and provision of storage facilities.

In order to consider these matters the Governments of the United Provinces and Bihar established in February, 1938, a Sugar Control Board. The Board meets either at Lucknow or at Patna and advises the provincial Governments on all matters connected with the sugar industry of the province that may be referred to it by them.

The present article does not touch one important aspect of the sugar industry, namely, that relating to *gur* and possible commercial by-products like power alcohol. These occupy a wide field and deserve separate treatment.

INSECTS AND MAN

By

S. Chowdhury, B. Sc. Ag. Assoc. I.A.R.I.

Insects are the most numerous forms of animals. They actually make up more than three-fifths of all known animals in the world; and of the something like 5,00,000 species of animals now known more than 3,00,000 are insects. Competent authorities estimate that the total number of species of insects in the world is from 1,000,000 to 10,000,000 with indications that the latter number more nearly approximates the number of species of insects in existence. It is this abundance of insects together with their extraordinary power of multiplying and their world-wide distribution that in part led a prominent man of science, Dr. Vernon Kellogg to say that if this were not the Age of Man this would be the Age of Insects.

But it is no mere academic interest in the abundance of insects that we are concerned about; it is their relation to human welfare. With the exception of domestic animals there is no other group or class of animals that affect us more vitally than the insect group. These creatures attack our domestic animals and spread disease among them, destroy our crops, our stored products, our clothes, furniture and indeed our everything almost. Marlatt has estimated that in the United States of America alone insects destroy farm crops to the value of about two billion dollars annually, to say nothing of the losses due to insects that carry diseases, which losses likewise run into enormous sums.

What is it about insects that makes them such formidable enemies of man? One of the reasons is that they are small and because of this they easily escape notice. Another is their high reproductive capacity, which in part counterbalance their small size. The descendants of a single female locust may in the fourth generation or at the end of about one and a half years number about 2,000,000. This in part

explains the tremendous locust swarms that devastate our economic crops. Huxley made the estimate that a single female aphid or plant louse, would in ten generations, which roughly speaking represents a period of five months, if all her descendants were to survive, produce a mass of organic matter equivalent to the bulk of 500,000,000 human beings or the entire population of the Chinese Empire. This of course would never happen because of adverse conditions that check the multiplication of the insect.

Fortunately for us we also find among insects some that are beneficial to us. Among these are those that pollinate our crops and those that yield us highly useful products such as the honey-bee and the silk-worm. Phillips once remarked that the honey-bee contributes to the wealth of the American nation about 100,000,000 dollars worth of honey annually to say nothing of its value as a pollenizer in which respect it is generally considered to be of still greater service to American agriculture. It is the only means by which the nectar in flowers can be collected and converted into one of the most delicious and nutritious of foods that if not so collected it would be wasted. True the ingenuity of man has produced artificial silk and honey but these faked products are far from equal to the natural products from the silk-worm and the honey-bee. Still other insects are beneficial because they prey on those that are harmful to us. If the insects would only quit fighting among themselves, they would overwhelm the whole human species. It is highly fortunate, therefore, that the insect world is 'a house divided against itself'.

There are also a number of insects that, so far as we know at present, cannot be classed as either injurious or beneficial in the strict sense of the words. But some of these may under altered conditions of agriculture become injurious sooner or later. In other words they are potential pests and need to be watched.

Because of this highly important role that insects play in man's economic life, the control of those that are harmful and the propagation of those that are beneficial should receive the attention of those who are interested in the welfare of the human race.

"THE FARMERS' FAIR"

By

K. F. A. Abel

The life-blood of India is *Agriculture* and the heart of India is the village. Agriculture is the oldest, safest and one of the surest means of existence in this country. Agriculture has not lost its popularity as in other countries where factories replace the farms. In India there are over 700,000 villages on the rich living vibrant earth which is the parent of millions of people, and their beginning and end as well.

The chief aim of the Farmers' Fair held at the Allahabad Agricultural Institute is to make the farmers' lot a much happier one than it was in days gone by, by showing them new implements, new seeds, new and better types of crops, vegetables and fruits, new and better breeds of cattle, new knowledge to enable them to increase their yields and thus improve their own standard of living in general.

The Ninth Farmers' Fair was held at the Institute from February 29th to March 2nd, 1940, under the management of Mr. Mason Vaugh, Agricultural Engineer aud Chairman, Farmers' Fair Committee.

At the opening meeting of the Fair on the evening of February 29th, Pandit Gopi Nath Kunzru, pointed out India's need, as an agricultural country, of the instruction and research in farming methods offered by such fairs and by such institutions. They should listen to these men, he said, who spent all their time finding methods 'to make ten maunds grow where only two grew before'. Dr. S. P. Verma, Accountant-General of the United Provinces, presided over the meeting. The students then presented a drama to give instruction to the village farmers, who attended the fair in large numbers. The evening programme also consisted of a 'bird-scaring' contest arranged by the Agronomy Department, which was the first of its kind. There were 15 contestants who were judged on their voices, their dramatic ability, and on the phrase or slogan which they shouted. The contest was much enjoyed by the spectators as well as the contestants.

The Dairy Department conducted two contests for village *gowalas*. An electric fence for keeping cattle out of cultivated fields attracted many of the visitors to the Fair.

Another new and interesting exhibit of the Fair was the extraction of *gur* (raw sugar) and making it into sweets. This exhibit, sponsored by the Gur Development Department of Cawnpore, showed the extraction of the *gur* from *ganna* (cane), boiling it to remove the impurities, and finally making it into sweets which were sold to the visitors. For this exhibit, two different cooking arrangements were constructed. The sweets made from the *gur* were so much liked that every day of the fair many visitors could not get any as it was quickly sold out.

At the second evening programme on March 1st, Mr. R.S. Pandit, head of the Rural Development Committee of the district, spoke on the necessity of improving Indian agriculture and the place such improvement would play in changing the status of the whole country. He emphasised the necessity of co-operation and co-operative associations as a means to such improvement. Mr. R. N. Basu, Chairman of the Allahabad Municipality, presided over the meeting. A drama showing the ways of improving farming and village life in general, was later staged by the labourers' school under the directions of the Social Service League of the Institute. At the end of the day's programme movies lent by the Red Cross were shown.

Although smaller than usual, the Rural Handicraft section of the fair presented 150 village contributions in addition to the large display of baskets made in village Mahewa. A few rugs were also exhibited from this village which were made by a purdah woman. Three of the Institute students exhibited pictures. Exhibits were received from six villages, Baraou, Shoyapurwa, Gangia, Mahewa, Ariel and Rasolpur; and also from Naini Girls' School, Mary Elizabeth Girls' School, and Mahewa Hindu Girls' School. The handi-craft work is carried on under the supervision of Mrs. M. Vaugh.

Prof. S. K. Rudra presided, and Pandit Iqbal Narain Gurtu was the principal speaker at the last day's meeting of the fair on March 2nd. Mr. Gurtu spoke about the importance of agriculture in India and the part that such agricultural

research institutions as the Allahabad Agricultural Institute could play in the improvement of this phase of Indian life.

Mrs. B. M. Pugh, wife of the officiating principal of the Institute, gave away the prizes, which included over Rs. 140 in cash and a number of cups and medals. The meeting terminated after the showing of film of *gur* processes, lent by the Gur Development Department of Cawnpore.

The ploughing contest was the most interesting item of that day's programme. Each of the eleven competitors was given a 40 yard plot and an institute plough and the results were judged on neatness and efficiency. The winner, Gokhul Kundi of village Marawni, received a Wah Wah plough with all the attachments, as the first prize. The second and third prizes were won by Someshwar of village Kharkauni and Ram Lal of village Markauni, respectively, who were each awarded a plough without attachments. The ploughman from village Sundarpur, coming from a distance of over three miles was awarded the prize for the competitor coming from the longest distance. Budhur Chamar won the prize for possessing the best pair of bullocks in the contest.

The refreshment stalls run by the horticultural, agronomy, dairy and home-making departments of the Institute were well patronised by the visitors to the show each evening. Additional exhibition space this year was provided by the new laboratory building for students of engineering where the exhibits of the agronomy department were put up.

Among the prominent visitors to the fair were Sir Digby Drake-Brockman, Khan Bahadur Abu Muhammad, Rai Sahib A. N. Shukla, the Rev. H. C. Balasundarum, Dr. B. K. Mukerji and Dr. C. H. Rice. About 500 soldiers from the local Indian regiments visited the fair during the period it was held. Altogether it was estimated that nearly five to six thousand people visited the Farmers' Fair which was a great success.

All are architects of Fate,
Working in these walls of Time,
For the structure that we raise
Time is with materials filled;
Our todays and yesterdays
Are the blocks with which we build.

Longfellow.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, UNITED PROVINCES

For February, 1940

I.—Season.—The rainfall in the first fortnight of February was general. The 3rd week was practically rainless while light rains fell in a number of districts in the last week. On the whole the rainfall of the month was above the normal in 37 districts, 12 recording above one inch, 9 above 2 inches, one above 3 inches and 2 above 4 inches.

II.—Agricultural Operations.—Agricultural operations are generally up-to-date. Pressing of sugar cane, preparation of land for and sowing of sugar cane and sowing of extra crops are in progress. Harvesting of *rabi* crops, mustard and rapeseed has commenced atplaces.

III.—Standing Crops and IV.—Prospects of the Harvest.—The standing crops are generally satisfactory and prospects are on the whole favourable. The general estimate of the outturn of *rabi* crops is expectedto range between 60 and 90 per cent. of the normal except at places affected by hailstorm.

V.—Damage to Crops.—Damage from hailstorm is reported from certain districts though loss is not considerable.

VI.—Agricultural Stock.—The condition of agricultural stock is satisfactory. Mortality from Hæmorrhagic Septicaemia has increased while other cattle diseases are on the decline as is indicated by the following figures furnished by the Director, Veterinary Services, United Provinces :

Diseases	January, 1940		February, 1940	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	2,515	1,336	2,387	1,199
Foot-and-mouth	8,562	24	2,984	21
Hæmorrhagic Septicaemia	54	42	264	220

VII.—Pasturage and Fodder.—Fodder and water are reported to be sufficient almost everywhere.

VIII.—Trade and Prices.—Prices of the chief food grains show a tendency to rise while that of gram has fallen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

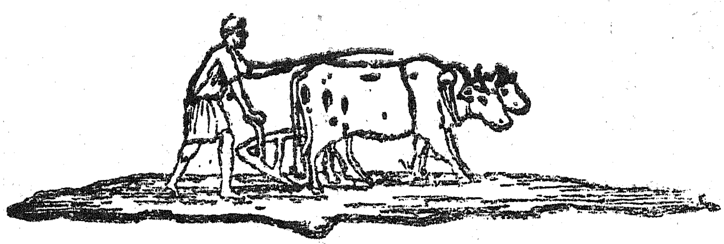
			End of January, 1940	End of February, 1940.
Wheat	...	...	4·049	4·086
Barley	...	...	3·138	3·183
Gram	...	...	3·878	3·823
Rice	...	...	4·387	4·644
Arhar Dal	...	...	4·907	5·006

IX.—Health and Labour in Rural Areas—Ample employment is available for the agricultural and labouring classes. Small-pox is reported from a number of districts.

RICHEST GRASS

One scientific investigation has revealed that grass when three or four inches tall is much richer in protein than when it is more fully matured. At this stage, it averaged twenty-two per cent. protein. When it had reached the degree of maturity usually desired for hay cutting, it averaged only eight per cent. protein The greatest value of pasture, then, would seem to be had when grazing is so conducted as to keep the grass growing vigorously, but not permitted to become tall and semi-mature.—*The Furrow.*

THE
ALLAHABAD FARMER



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An Editorial

Dr. T. W. Millen:

Ever since the departure of Dr. B. H. Schneider for America, the Allahabad Agricultural Institute was deprived of the services of a very able animal geneticist, perhaps the most able that ever came out to India. When the Institute learned that he would no longer be available, efforts were made to look for another man to take his place. And we are glad to learn that the Institute has now secured the services of Dr. T. W. Millen, who will come out to India soon after the opening of the next college session. Dr. Millen is not new to India as he was for some time a professor of Biology in the Woodstock College, an institution for American children in this country, and which is situated in Mussoorie. Since going back to America Dr. Millen has specialized in Veterinary Medicine and animal biology, and is at present engaged in research in a serum institution in America. We are confident therefore that Dr. Millen will not only fill the place at the Institute, made vacant with the departure of Dr Schneider, with credit, but that he, through his knowledge in Animal Biology and

Veterinary Science will bring the relation of these two aspects of the subjects of Animal Husbandry much closer together. We believe that there has been too much wire pulling on the part of the veterinarians in this country who claim that cattle diseases should be treated as a separate department from that of the agricultural department, and who claim that the latter is not competent to have men trained in veterinary science to handle the cattle diseases which are a stumbling block to animal breeding in this country. Cattle breeding is to our mind out and out a matter to be dealt with by the Agricultural Department And the treatment and study of cattle diseases in connection with animal breeding should to our mind be an adjunct of the Animal Husbandry section of the Agricultural Department.

Mr. A. T. Mosher and Mr. Maxton Strong

When the Allahabad Agricultural Institute some time ago decided to place Mr. A. T. Mosher who came out to India to join the Agricultural Engineering section of the Institute, in charge of a new section to be called the Extension Department, the engineering section lost the services of an assistant engineer whose work as a teacher in that department was very much appreciated by the students. Mr. Mosher and his family have just left this country for a furlough period in America During this furlough Mr. A. T. Mosher has been charged with the responsibility of raising money for the new section of which he will be the Head. We hope that this department will get the support which it deserves as we believe that the methods of reaching out to the Indian farmer is one of the weakest links not only of this institution, but also of the agricultural departments in this country. While we believe that there are not very many things which we have discovered as a result of our researches in this country which we can pass on to the cultivators, yet there are improvements which we are sure would benefit the country if they are taken up by the cultivator. Such improvements should be systematically passed on to the cultivators if our country should benefit from the results of agricultural researches now begin carried throughout the country.

We learn with pleasure that the Institute has also secured the services of Mr. Maxton Strong to assist in the Engineering

section of the Allahabad Agricultural Institute, in place of Mr. A. T. Mosher. This section of the Institute has been so much over-burdened during the last few years that it had not been possible for it to grow as fast as the needs required. With the arrival of Mr. Strong we hope this need would to a large extent be met. May we say in this connection that it is our conviction that the training in agricultural engineering of agricultural officers in the country is hopelessly inadequate. Mr. N. G. Charley, a former research engineer of the Madras Agricultural Department, pointed out in one of the recent meetings of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India, that many demonstrators in Madras could not even name the parts of implements or describe their functions correctly. He therefore pointed out that better teachers in agricultural engineering were required and that they should be sent abroad for training in factories and on farms. Their training must of course be founded on a sound knowledge of Indian conditions

We also fully agree with the remarks made by Mr. W. Roberts in the above meeting in this connection. He said: "In the past there had been a tendency to work from the top downwards instead of from the bottom upwards. Most of the earlier recruits to the Agricultural Department started by trying to introduce the English plough or a modification of it instead of by working up from what was already in use in the country and seeing what improvement could be effected. The first duty of each province in this connection should be to have a reliable record of indigenous implements in use and of the places where they were used and if possible to set up some kind of museum. This sort of work was being done in Great Britain in agricultural colleges and a great deal of attention was being paid to the historical aspect of implement improvement. The lack of record of improved implements at provincial agricultural colleges in India was a serious handicap in the way of improving their performances and extension."

The Agricultural population is the back-bone of India.

—*Lord Linlithgow*.

Agricultural Education in India.

THE report of the educational commissioner on the progress of education during the quinquennium 1932-37 shows that the expenditure on Government agricultural colleges was Rs. 5,42,950 in 1936-37 as against Rs. 7,70,167 in 1931-32. India is very backward in respect of agricultural education It is curious that while on the one hand the spokesmen of the Government have been telling us that the improvement of Indian agriculture is essential to the prosperity of the country, on the other, the Government should reduce their expenditure on agricultural education on which the improvement of Indian agriculture so greatly depends. The present Viceroy in a speech at Delhi emphasizing the importance of agriculture drew attention to 'the significance of agricultural progress in its reaction on the agricultural population which is the backbone of India.' May it be hoped that the Viceroy will inculcate some of his fervour in the Government of India? It is significant how much interest even some foreigners take in the agricultural education of Indians. It will be recalled that the Imperial Agricultural Research Institute at New Delhi, which is one of the best institutions of its kind in Asia, was the result of the generous donation of £30,000 by Mr. Henry Phipps, a Chicago philanthropist. In our own city we have the Allahabad Agricultural Institute which is conducted by American missionaries. Among educational institutions run by non-official agencies in these provinces we have not seen any which is better staffed and equipped and more efficiently managed than the Allahabad Agricultural Institute. Students have come to this institution from all over India—from Kashmir to Assam, and even from Persia, Mesopotamia and the Fiji Islands. Dr. Higginbottom, Principal of the Institute, claims that 'there is comparatively little unemployment among the men we have turned out.' This claim was endorsed by the Sapru Committee on Unemployment who scrutinized the register of former students of the institution. When outsiders are doing so much for the cause of agricultural education in India, it ill becomes the Government of this country to economise in expenditure on this important subject.—"*The Leader*," May 1, 1940.

NOTES ON THE GRADING TRIALS OF APPLES CARRIED IN RAMGARH (DISTRICT NAINI TAL) DURING THE FRUIT SEASON IN THE YEAR 1939

By

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Object

With a view to carry through such preliminary work as fixation of grades and standard for apples for inclusion in the Government of India Agricultural Produce (Grading and Marking) Act 1937, an experimental apple grading station was started by the United Provinces Marketing Section at Ramgarh (District Naini Tal) as sanctioned in Government Order No. 1052A/XIIA, dated July 29, 1939, in co-operation with the Central Marketing Staff of Government of India.

Progress of Work

The work was undertaken in two of the leading orchards, Applegarth Estate and Umagarh Orchard, so that the tentative grades of the main commercial varieties of apples produced in the Kumaon hills may be drawn. In addition to these two orchards where grading, marking and marketing continued simultaneously the work of demonstrating the "AGMARK" grading and marking of apples to the small growers was also taken in hand at a central godown from time to time in order to enable the small growers to fully realize the advantages accruing from such an improved method of grading the produce.

For this purpose it was considered necessary to keep the producers informed about the prevailing prices and the

market demand and therefore adequate arrangements were also made in the important consuming markets of the United Provinces to obtain comparative prices of graded and ungraded fruits by weekly telegram and these were pasted in a black-board kept at a central place with contents translated into Hindi and Urdu throughout the season for the guidance of the growers.

The actual date of commencement of work was from 18th of July in Applegarth Estate and from 19th July in Umagarh orchard. Owing to over a month's delay in the commencement of work, as the apple season starts from June, grading trials with some of the early varieties could not be undertaken; and this was particularly marked during the year owing to an early crop on account of excessive heat, and thus the work had to be spread for three months only instead of four as was originally proposed.

During this period the tentative "AGMARK" specifications of the following commercial varieties of apples were drawn:—

Fanny	Coxe's orange pippins
London pippin	King of Tomkins County
King of the pippins	Peas goods Non such
Golden pippins	King David
James Grieve	Delicious
Ribston pippins	Rymer (Kumaon favourite)

On the basis of these specifications the total quantity of apples handled in "AGMARK" grading were 2638 packages or 309646 fruits in counts or 92639 lbs. in weight as follows:—

Grade designation	Total Packages	Total Fruits	Total Weight in lbs.
Super	503	36373	17189
Extra Fancy	535	52725	18869
Fancy* (Selected)	994	126742	35371
Commercial	540	85168	18898
Domestic	66	8638	2312
Total ..	2638	309646	92639

* In case of cooking varieties of apples the grade designation used was selected instead of Fancy.

In order to gauge the financial aspect of the grading experiments and to obtain comparative price figures for "AGMARK" graded produce as against the produce handled by the orchardists in their own way, trial consignments were also sent from the grading stations to the same market on the same date. As the growers realized that there is a loss in sending fruits without "AGMARK" grades the number of consignments so despatched were very little and this was particularly marked in the consignments sent from the Applegarth Estate. The following are the true copies of the notes, which express the views of these orchardists in this connection:—

Copy of a note from Applegarth Estate, Ramgarh, Naini Tal, Kumaon, U. P. dated October 25, 1939.

"The United Provinces Marketing Section commenced "AGMARK" grading of apples on this Estate from the 3rd week of July on an experimental basis.

This method of marketing our produce with "AGMARK" labels definitely improved prices, especially in its earlier inception. The bulk of our crop was marketed with "AGMARK" labels.

We are very grateful to the U. P. Marketing Section for all the help rendered in this connection and will be glad to co-operate with them again next season, in the same way."

Copy of a note from Umagarh Fruit Gardens, P. O. Ramgarh, district Naini Tal, dated 5-10-'39.

"The Marketing Section commenced grading in my orchard this fruit season. This type of grading proved very useful. The markets in the plains were very unfavourable during the year, but grading helped to some extent in obtaining better rates. I am always prepared to co-operate in this type of work. I am very thankful to the Marketing Section for all the help rendered in this connection."

SD. KAMLA PATI JOSHI,
Proprietor,
Umagarh Fruit Gardens.

From the comparative prices of the consignments sent from the grading stations during the season to compare the price differences between the "AGMARK" graded fruits and those handled by the orchardists in their own way, it will be evident that all the consignments handled in "AGMARK" grading fetched a greater premium per case than those handled by the orchardists in their own way. The following are the average comparative prices per case of the fruits handled in "AGMARK" grading and also by the usual method in the experimental stations during the season :—

Grade designation	Names of the grading station	"AGMARK" graded produce per case	Graded by the orchardists by the usual method per case	Difference per case
		Rs. a. p.	Rs. a p.	Rs. a. p.
Super ..	Umagarh ..	6 7 1	5 9 9	0 13 4
	Applegarth ..	6 4 7	5 13 4	0 7 3
	Marketing Section	..	..	..
Extra Fancy	Umagarh ..	5 3 8	5 3 1	0 0 7
	Applegarth	7 3 3	6 6 3	0 13 0
	Marketing Section	5 0 0	3 1 0	1 15 0
Fancy (Selected) cooking,	Umagarh ..	5 7 10	4 12 3	0 11 7
	Applegarth	7 0 6	6 8 2	0 8 4
	Marketing Section	5 0 0	3 8 0	1 8 0
Commercial	Umagarh ..	5 13 0	5 1 4	0 11 8
	Applegarth ..	6 5 2	5 12 8	0 8 6
	Marketing Section	5 10 0	4 9 4	1 0 8
Domestic ..	Umagarh ..	5 11 8	5 3 9	0 7 11

The average increase in prices of "AGMARK" graded produce per case as against the fruit handled by the orchardists in their own way from all the three stations combined was as follows :—

Super	Grade	10 as.	$3\frac{1}{2}$ p.	per case increase.
Extra Fancy	,,	14 as.	$10\frac{1}{12}$ p.	,, ,, ,,
Fancy	,,	14 as.	8 p.	,, ,, ,,
Commercial	,,	12 as.	$3\frac{1}{12}$ p.	,, ,, ,,
Domestic	,,	7 as.	11 p.	,, ,, ,,

This goes to prove that the markets responded very well to this improved and scientific way of grading the produce and made the producers realize its importance in the production centre.

Concluding Observations and Recommendations

The grading trials conducted during the season with the tentative "AGMARK" grades that were drawn for the purpose have shown very encouraging results in the orchards where this method was adopted on an experimental basis and the bulk of the produce of Applegarth Estate and Umagarh orchard in Ramgarh was handled with "AGMARK" grades during the apple season in the year 1939 and these orchardists fully co-operated in the work taken in hand and have expressed their full desire to co-operate similarly in the next fruit season.

In view of these results it would appear necessary to extend the area of operation in the ensuing fruit season and for this it is essential to have the full co-operation of the orchardists in the Kumaon hills.

The best way would be for the growers to form themselves into a co-operative association and thus also make it possible for the small growers to pack and grade their produce according to the "AGMARK" standards and grades.

As a first step towards this it will be necessary for all the leading orchardists to apply for certificate of authorisation to grade their produce according to these "AGMARK" grades. And for small growers, grading stations will have to be opened by the Government in the concentrated areas of production like Bhowali, Ramgarh, Motia Pathar, Muktesar, Ranikhet and Jalna. Such a scheme has been prepared and submitted to the Director of Agriculture, U. P., for sanction of funds.

Some of the leading growers that were approached with a view to get their opinions regarding the tentative "AGMARK" grades that were drawn, during the season, have expressed their desire that the apples should have only

three grade designations *viz.* Super, Fancy and Selected and all their marketable stuff should come within the limits of these grades. In view of this and with the help of the provisional grades drawn for some of the varieties a consolidated statement appended in the end of this note has been prepared and if approved "AGMARK" grading will be taken up on these lines in the Kumaon hills from the ensuing fruit season.

Consolidated Provisional Grade Specification of Apples Grown in the Kumaon Hills.

(i) General Characteristics—

GRADE NAMES—Super, Fancy, Selected (Dessert apples)
Super, Fancy, Commercial (Cooking apples).

Ripeness— Dessert apples shall have reached that stage of maturity which allows the subsequent completion of ripening process.

Size— Variation in diameter of fruits in any one package not to exceed ¼".

Blemish— Super—Entirely free from blemish (other than russetting of apples characteristic of the variety); shape to be normal.

Fancy—Free from such blemishes or mechanical injuries as may affect keeping quality; skin blemishes (other than russetting of apples characteristic of the variety) not to exceed a total of ¼ inch square on any one apple. Shape to be normal.

Selected Commercial—Free from such blemishes or mechanical injuries as may affect keeping quality, skin blemishes (other than russetting of apples characteristic of the variety) not to exceed a total of ½ inch square in any one apple; badly mis-shapen fruits to be excluded

Packs— All packages to be fully lined with white paper for super grade, cleaned and dried moss grass

or pineneedles or wood wool may be used at the top and bottom of the packages, wrapping papers to be used on all fruits.

Packages to be of the following standard sizes and only one variety to be packed in each package diagonal pack :—

Full Bushel Box	... $12'' \times 11\frac{1}{2}'' \times 10\frac{1}{2}''$
Half ,,	... $18'' \times 11\frac{1}{2}'' \times 5\frac{1}{4}''$
Quarter ,,	... $18'' \times 11\frac{1}{2}'' \times 2\frac{5}{8}''$

(ii) Special Characteristics—

APPLES, DESSERT.

Super— Size—Minimum diameter $3\frac{1}{4}''$.

Colour— Varieties which are known to colour wholly red, to average 50 per cent total surface coloured ; no apple to be less than 30 per cent coloured. Striped varieties to be considered as fully coloured on the surface which is striped with red. Varieties which partly colour red to average 25 per cent. of the total surface coloured; no apple to be less than 10 per cent coloured. Varieties which do not colour red to be uniform in shade throughout the pack.

Fancy— Size—Minimum diameter $2\frac{3}{4}''$.

Colour—Varieties which are known to colour wholly red to average not less than 25 per cent of the total surface coloured, no apple to be less than 10 per cent coloured, striped varieties to be considered as fully coloured on the surface which is striped with red; varieties which partly colour red to average 10 per cent coloured, varieties which do not colour red to be uniform in shade throughout the pack.

Selected— Size—Minimum diameter $2\frac{1}{4}''$.

Colour—Colour to be uniform throughout each package.

APPLES COOKING.

Super— Size—Minimum diameter $3\frac{1}{2}''$.

Colour—Colour to be uniform throughout each package.

Fancy— Size --Minimum diameter $3''$.

Colour—Colour to be uniform throughout each package.

Commercial— Size—Minimum diameter $2\frac{1}{2}''$.

Colour—No colour requirement.

'Diameter' means the largest transverse diameter taken at right angles to the line running from stalk end to blossom end.

'Blemish' includes marks due to fungus diseases, insect pests, hail-storms, spray, etc., in which the damaged skin has healed.

TOMATOES FROM POTATOES

William Kennard, an amateur gardener of Portland, Ore. U.S.A., had the surprise of his life when he went to dig some potatoes. Tomatoes had come up where he had planted potatoes. Puzzled, he pulled up the plants and examined the roots; there were potatoes on them.

Botanists also are puzzled. They admit that the potato and the tomato, as plants, are closely related but they cannot explain the occurrence of two different "fruits" on one plant. However, they know that the potato plant occasionally does some queer things. Sometimes a potato plant will produce a crop of small, green potatoes above ground. These grow at the joints where the branches run into the main stem. This subsidiary crop does not prevent the plant from producing a normal crop of tubers below ground.

If we are not responsible for the thoughts that pass our doors, we are at least responsible for those we admit and entertain.—C. B. NEWCOMB.

THE MOISTURE OF THE SOIL

S. CHOWDHURY, B. SC. AGRI., ASSOC. I. A. R. I.

The importance of a proper amount of soil moisture in crop production cannot be overestimated. Of the various factors affecting crop production the most influential has been recognised to be water supply. Water is one of the external factors in plant growth in that it is necessary in the processes of weathering. It also functions as an internal factor in plant development, inasmuch, as it maintains the turgidity of the plant cells, acts as a carrier of food materials, functions as a regulator, and can actually be utilised as a source of hydrogen and oxygen. These direct or indirect relations of water to plant growth may be considered under three heads as follows:

(1) 'Water acts as a solvent and a carrier of plant food materials. It is therefore a medium of transfer for the mineral and gaseous elements from the soil to their proper places within the plants.'

(2) 'As a food water either becomes a part of the cell without change or is broken down and its elements are utilised in new compounds.'

(3) 'Water in maintaining turgidity in equalizing the temperature by evaporation from the leaves and in facilitating quck shifts of food from one part of the plants tlo another acts as a regulator during assimilation and whie synthetic and metabolic processes are going on.'

Moisture and Soil Temperature.—The soil moisture exerts a very important influence through its effect on the temperature of soils. It is a fact that five times as much heat, or even more, is required to warm one cubic foot of water as is required to warm equally one cubic foot of soil. Thus a saturated water-logged soil is always spoken of as a 'cold, wet soils.' Such soils are late to germinate seed, since most seeds must be warmed above 45F. before they can sprout,

and plant growth is favoured by temperatures ranging from 60 to 80F.

Water Requirements of Plants.—The upward movement within the plant of water containing plant nutrients is rendered possible by the process of transpiration whereby water in the form of vapour continually escapes from the leaves. The quantity of water thus lost through transpiration is considerable. The expression *transpiration ratio* or *water requirement* of the plant denotes the pounds of water transpired for every pound of dry matter produced in the crop. This figure ranges from 200 to 500 for crops in humid climates and almost twice as much for crops in arid climates. It is found to depend upon a number of factors such as the crop, climate, amount of water in the soil, fertility of the land, etc. The addition of fertilizers has been found to reduce considerably the water lost by transpiration.

The Dissipation of Rain Water.—The common source of soil moisture is rain water. A part of the rain water is speedily evaporated back into the air. Another part of the rainfall gathers into drops, these coalesce into rills; they in turn form little brooks and the surface drainage of a field or country results. The quantity of rain water that meets this end varies with the compactness of the surface soil, the amount and character of the vegetation, the slope and surface configuration of the land and rate of evaporation. Thus a sudden dashing shower falling on a bare, compact, clay surface gives rise to a large quantity of surface water which finds its way into streams, rapidly if the slope is great, more slowly if it is small. The moisture from such a shower is chiefly disposed of by surface drainage or 'run-off' and vegetation derives little benefit from it.

A third part of the rainfall passes slowly into the soil. It is a mistake to suppose that it sinks into the soil through the innumerable pore spaces which exist between the individual soil grains, or that these pore spaces are filled until the soil is saturated. On the contray, in the case of all of the heavier clays and loams, in fact in all but the most porous sands, the rainfall penetrates the soil chiefly through

cracks, joints, crevices, angleworm burrows and the tubular spaces left by the decay of plant roots. Only a gentle, long-continued 'soaking' rain is capable of utilising fully the many avenues of circulation presented by the average arable soil.

However, when the atmospheric moisture has begun its career as soil moisture by passing into the larger openings it speedily soaks into the mass of the soil through the smaller pore spaces that are found in even the stiffest clays.

In a majority of cases even a large rainfall is rapidly absorbed within the surface six inches or one foot of ordinary cultivated soils. Some part of the water does not cease its movement at this stage. It continues to fall through the larger openings until it meets with some less pervious layer of clay or with rock. It may then flow away along the surface of such a stratum, finally escaping at a lower level in the form of springs, or it may be denied such an outlet and accumulate as ground water.

The water that runs off the surface is of little use to vegetation. That which forms springs by flowing under ground is usually of small value to growing plants. That which accumulates as swamps or marshy spots is of positive harm to all but a few species of cultivated plants.

So far as agriculture is concerned, it is the relatively small amount of moisture that remains absorbed in the partially dry surface layers of the soil on which crops depend not only for their water supply but also for their supply of mineral plant food. This soil moisture usually forms rather thin films surrounding the small soil grains and occupying the small angles where they touch. This moisture is in contact on one side with the mineral and dead organic matter of the soil and on the other with the soil air which almost always occupies a large part of the open porous spaces in the soil. When plants are growing on a soil their roots and root hairs are also in contact with the soil, the soil moisture and soil air.

Forms of Soil Water.—There are three forms of soil water......*hygroscopic*, *capillary* and *free* or *gravitational*

water. These forms differ not in their composition, but in the position that they occupy in relation to the soil particles.

The *hygroscopic* and *capillary* water are both film forms; that is they surround the soil particle, being held partly by the attraction of the particle and partly by the molecular attraction of the liquid for itself. The *hygroscopic* film is very thin, being water of condensation, or absorption. When this film is satisfied and moisture is still present, the *capillary* water film begins to form. The general difference between the two forms may be considered as being not only one of position, but also one of movement, this power being possessed only by the *capillary* film. With a change in any controlling condition such as temperature, *hygroscopic* water may change to *capillary*, or *capillary* water to *hygroscopic*, as the case may be. As the *capillary* water continues to increase and the film becomes thicker and thicker, a point is at last reached at which gravity overcomes the surface tension of the liquid and drops of water from which tend to move downward through the air spaces being now subject to movement by the attraction of gravity. *Free* or *gravitational* water then also becomes present in the soil. If water is still added, the *gravitational* water continues to increase until the air is almost entirely displaced and a saturated condition results. There may be a change of *capillary* to free water and of *free* water to *capillary* with a change of structure, temperature, or pressure.

Hygroscopic water.—The *hygroscopic* water in a soil has been spoken of as the water of condensation or absorption. This water is of little, if any, agricultural importance. It is the water that remains when a soil is thoroughly air-dried. This form of water is held tightly by the soil grains, does not move under normal conditions, and cannot be utilised by plants. It can be forced from the soil by heating to the boiling point. The amount varies from 2 per cent. in sand to as much as 40 per cent. in muck. Ordinary loams contain from 4 to 6 per cent.

Capillary water.—It is in this form that water is utilised by plants. The root hairs take it in from the loosely

held films surrounding the soil grains. As the root hairs draw on the films with which they come in contact, surface tension causes a movement of capillary moisture to the films of reduced thickness, and thus the supply of *capillary* water is replenished. In the same way this form of water moves upward by *capillarity* as evaporation takes place from the surface of the soil.

Plant growth is dependent on an adequate supply of *capillary* water. By means of this water the soil plant food enters the plant. The amount most favourable for growth....that is...the optimum moisture content of soils varies with the character of the soil. It is approximately 20 per cent. for sand, 30 per cent. for clay and 200 per cent. for muck. As the amount is reduced below the optimum growth is retarded; and in extremely dry seasons crops may wilt and even die because of an inadequate supply of *capillary* water.

Free or Gravitational Water.—As soon as the *capillary* capacity of a soil column is satisfied, further addition of moisture will cause the appearance of *free* water in the air spaces. By the attraction of gravity, this water moves downward through the earth at a rate varying with soil and climatic conditions. In general the flow is governed by four factors.....pressure, temperature, texture and structure. *Free* water is injurious to crops if it accumulates in the area of root growth. *Free* water is of value in replenishing the supply of capillary water. For this reason it is desirable to have the water table just below the zone of root development.

The Conservation of Soil Moisture.—The importance of soil moisture is plainly evident. It has already been said that for a normal yield of any crop, a large amount of water is necessary. Were the transpiration of plants the only source of loss of soil moisture, the question of raising crops with given amounts of water would be a simple one. Three further sources of water loss, however, usually operate in the soil tending to lower the amount that would go towards transpiration. These are (1) *run-off over the surface*, (2) *percolation*, and (3) *evaporation*. Some control of soil

water is therefore necessary for the needs of the plant. The amounts lost under (1) and (2) are much less in arid and semi-arid than in humid conditions, but loss through evaporation is great and is of especial consequence as it competes directly with the crop.

Run-off Losses.— Run-off losses vary with the rainfall and its distribution, the slope of the land, the character of the soil and the vegetative covering. In some regions they may amount to as much as 50 per cent. of the rainfall, but such losses are inconsiderable in arid tracts. The amount of run-off would be greatly reduced by altering the physical condition of the soil so as to enable it to retain as much of the rain water as possible. Good tillage, deep ploughing and the addition of organic matter would thus help to retain the rain water and so reduce run-off. The provision of bunds is an effective means of preventing run-off. On steep slopes cultivation across the incline and terracing are some of the means adopted to reduce run-off.

Percolation Losses.—Losses from percolation result wherever the rainfall entering the soil becomes greater than the capillary capacity of the soil. Besides water some salts which may serve as plant nutrients are apt to be lost through percolation. Such losses depend largely on the amount and distribution of the rainfall and the capacity of the soil to hold water. Percolation is influenced also by evaporation and the presence of a crop. On uncropped land in humid climates percolation losses may amount to 50 per cent. of the rainfall. Evaporation and the presence of a crop greatly reduce the percolation losses. Percolation may be controlled by improving the absorptive capacity of the soil by good tillage and the addition of organic matter. In dry climates, however, owing to excessive evaporation, percolation losses are of minor importance.

Evaporation Losses.—Loss due to evaporation on uncropped land may amount from 50 per cent. of the rainfall in humid regions (the rest being lost by drainage) to cent per cent in arid sections of the country where there is little or no drainage. The rate of loss of water by evaporation may be

very materially reduced by drying the surface thoroughly whereby the capillary movement of the soil water near the surface is very much retarded. This naturally occurs if sufficient time occurs between rains. The drying however has to be rapid if evaporation losses are to be reduced effectively. Under favourable climatic or weather conditions, the rate of drying may be so rapid that no supplemental treatment of the soil to hasten the process is necessary. Where the process is likely to be slow, it would be desirable to cultivate the soil after each heavy rain in order to produce a dry surface layer before serious losses from lower depths have occurred. The loosened soil forms what may be termed a soil mulch and serves to reduce evaporation losses considerably.

The effectiveness of the soil mulch in reducing losses due to evaporation seems to depend upon a variety of factors connected with the crop, the climate, the season and the soil. The failure to take these into consideration seems to be responsible for much of the discrepancy observed between the results obtained from laboratory experiments and those conducted under field conditions.

Fallowing.—Bare fallowing is often an effective means of adding to the store of water inside the soil and where the annual rainfall is insufficient for the successful raising of a crop, it has been found possible to raise good crops by fallowing every alternate year or once in three years, the fallowed land being ploughed and harrowed at intervals so that the soil may receive and hold all the rainfall.

Ploughing and Cultivation.—Ploughing and cultivation are processes intended to prepare a seed bed for germinating and growing plants. At the same time they are the most common methods of providing for the accumulation, storage and retention of soil moisture. Rainfalling on a puddled clay surface runs off. If the puddled clay surface is carefully ploughed, so that a fine porous layer of dirt is formed, 'as mellow as an ash heap', a much greater amount of moisture is absorbed and retained by the soil, its distribution is more even, and the washing away of valuable surface soil is largely prevented.

Summary.—The dominant facts connected with the problem of soil moisture may be summarised briefly:

(1) Soil moisture is an essential part or factor of the soil, since it prepares and distributes the food supply of plants;

(2) Soil moisture largely dominates the temperature of soils, and hence influences the vitality of seeds and plants;

(3) Soil moisture admits air to the soil or excludes it, and all growing parts of a plant must have air with the oxygen it contains;

(4) Moisture in slow motion in the soil and not saturating it is uniformly beneficial to plant life even in large amounts;

(5) Moisture stagnant in soils, or saturating them, though in motion is uniformly harmful to all plants except species adopted to swamps;

(6) The problem of securing, distributing, conserving and supplying soil moisture is a fundamental problem in agriculture, and many failures in farm management may be traced directly to a failure on the part of the farmer to understand or to solve this problem;

(7) The control of the kind and the amount of crops raised on the ordinary soil is so closely related to the control of soil moisture that this one factor in crop production is the dominant factor in all ordinary agriculture.

THE WORLD'S ANIMAL POPULATION

Horses	75,000,000	Ducks	100,000,000
Cattle	600,000,000	Fowls	1,400,000,000
Sheep	620,000,000	Elephants	100,000
Goats	80,000,000	Lions	100,000
Pigs	290,000,000	Tigers	150,000
Asses	28,000,000	White-tailed Gnus	150
Mules	13,000,000	Gorillas	1,500
Camels	6,000,000	Parvine's Rhino	68
Turkeys	17,000,000	Gannet	156,000
Geese	60,000,000	St. Kildra Wren	136

All Birds .. 100,000,000,000

A VERY SIMPLE AND INEXPENSIVE METHOD OF RECLAIMING USAR LAND

By

BISHAN MANSINGH

Fatehpur

The areas of different kinds of soils in the United Provinces are in round figures as follows :—

(1) Net cropped area : 35,500,000 acres.

(2) Forest : 2,850,000 acres.

(3) *Reh* (Alkali) Land : 2,000,000 acres.

(4) Barren Land : 3,000,000 acres.

(5) Culturable waste : 9,900,000 acres.

(6) Total area of Land : 65,000,000 acres.

Thus barren land and culturable waste comprise an area of one crore and 30 lac acres. Of this about half should be made culturable while the remaining half may be converted either into grazing ground or forest land.

The conversion of even half of the present useless land will considerably add to Government revenues, reduce the excessive pressure on land and provide employment to thousands of people.

This problem is of so vital importance and is full of so many possibilities for the betterment of every one concerned that the Government should give immediate effects to the recommendations of the *usar* Reclamation Committee and appoint a separate branch under the Director of Agriculture to carry out this work. Half of the total amount of money allotted for rural development department should be utilised for this work and a special plan with a time limit should be laid down for making this useless land useful.

At the outset it appears to be advisable to understand well as to what is the *usar* or alkali land, how the presence of alkali in the soil affects vegetation and what is the texture of such land.

Alkali and Poor Soil Aeration

Howard writes about *usar* land as follows:—

"The formation of alkali land in India is intimately connected with irrigation. Except on very permeable soil any tendency towards over irrigation is almost certain to increase the amount of alkali salts. Where these salts are present in injurious amounts, they appear on the surface in the form of snow white or brownish black incrustation known as *reh* or *kallar*. The former or white alkali consists largely of the sulphate and chloride of sodium, the latter (the dreaded black alkali) contains sodium carbonate in addition and owes its dark colour to the fact that this salt is able to dissolve the organic matter of the soil. According to Hilgard sodium carbonate is formed from the sulphate and chloride in the presence of carbon-dioxide and water. The action is reversed in the presence of oxygen.

The occurrence of minute quantities of alkali salts in the soil has no injurious effects on crops or on the soil organisms. It is only when the proportion increases beyond a certain limit that they first interfere with the growth and finally prevent it altogether. The action is a physical one and depends on what is known as osmotic pressure of solutions, which increases with the amount of dissolved substance. For water to pass readily from the soil into the roots of plants the osmotic pressure of the cells of the root must be considerably greater than that of the soil solution. If the soil solution becomes stronger than that of the cells, water will pass backwards from the roots to the soil and the crop will wither. This state of affairs occurs when the soil becomes charged with alkali salts beyond a certain point. The crops are then unable to take up water and death results. The production of these salts in injurious amounts is found to be closely associated with the texture of the soils; If the soils are open, permeable, and well aerated alkali salts are absent. On the other hand deep layers of stiff, heavy, poorly aerated clays are most certain to be affected by the alkali when such areas are brought under perennial irrigation. Recent investigations in Mesopotamia have furnished interesting confirmation of the connection between alkali and poor soil aeration."

Fortunately in our part of the country such land is generally found only in patches and big tracts are very rare.

What we find everywhere are vast areas of barren land. These differ from the land described above only in so far as the amount of salt in such land is less than that in the *reh* land and consequently there is some vegetation on such land for a few months in the year. If we, for the present, leave aside the *reh* land, which is much more difficult and is only 20 lac acres in area, and only reclaim the less injurious land which lies useless and is about one crore and 30 lac acres, we will be doing a great service to our country and this work will keep us engaged for many, many years to come.

Further the experience which we will gain by reclaiming comparatively less difficult land will enable us to deal more successfully and effectively with the really bad soil. In both kinds of soils the difficulties to be met with are the same; the difference is in degree only, and the same process of reclamation will have to be applied in both the soils. There were several patches of white *usar* in the paddy plots at my Bilanda farm, but now the paddy crop grown on those patches is just as good as that grown on other lands.

Vast areas of barren land such as those that exist between Ajgain Railway Station and Lucknow on the Cawnpore-Lucknow line may be taken up for reclamation to begin with. Canal water will be available to irrigate this land if anybody requires it.

Generally all *usar* lands are made up of deep layers of stiff, heavy, poorly aerated clays devoid of all humus and containing injurious salts in an abundant degree. Therefore in order to make them culturable we have: (1) to remove the injurious salts, (2) to make them friable, (3) to open them and make them permeable, and (4) to add humus to them.

The Four Steps

(1) The cheapest and the best way of removing injurious salts from the soil is to make earthen embankments one foot high and two feet broad round the selected land for reclamation. The embanked land besides holding water that falls on it should have openings to receive more water from the adjoining lands. If the area is very big it should be divided into plots of convenient sizes so that every inch of the land

remains under water for at least a week or ten days at a time. During this period the injurious salts of *usar* soil will come up on the surface and get diluted in the collected water. This water should then be allowed to escape. This process is to be repeated as often during the rains as the rainfall affords opportunities. Unless these injurious salts are got rid of, no regular vegetation is possible on *usar* lands. The strong solution of salt in the soil draws water from the plant instead of passing the same into it and under such conditions the plant naturally dies of drought. Where there are no *nalas* (channel) for carrying away the brackish water, *kachcha* (not strongly made) wells might be dug to the depth of the sand beneath. Such wells will drain out enormous quantities of water.

(2). When the quantity of injurious salts is thus reduced, a small quantity of slaked lime should be applied to the land under reclamation. This will make the soil friable besides producing other good effects on the soil.

(3) After the rains are over, and sometimes even before that, it will be found that the land which had been under water, would crack into small irregular pieces or flakes. Through these cracks the sun and the air will act upon the subsoil and the bacteria also will be able to develope in it.

(4) The organic matter brought down by the rain water and the roots of grass and other vegetation will provide food for bacteria which will thrive and improve the soil by fixing nitrogen there. The broken down remains of plants and animals called 'humus' is very rich in plant food. The roots of every kind of vegetation and specially of paddy plants when cut down from a height of nine inches supply a large quantity of plant food to the soil. Dried leaves, straw and undecomposed manure open the soil. *Jharberi* seeds germinate even on very poor soils, and its roots go down very deep. So also does the *madar* or *ak* plant. When the injurious salts have been removed in one or two seasons, every effort should be made to grow any kind of vegetation that can germinate on the land under reclamation. If the land is to be converted for grazing purposes only, babul seeds should also be sown inside the *jharberi* shrubs and under the branches of *madar* plants. Babul seeds germinate

more easily in such places than on open land. The roots of such trees open the soil to a long depth. When the land is thus opened up by cracks and roots of trees and has also got humus in it, it becomes permeable and the texture of the soil is quite changed, so much so that the paddy crop, if farm-yard manure and water for irrigation is available, can be grown very successfully on it. It can also produce good fodder crops and provide good grazing ground. In the early stages the converted land should be reserved for these crops only. By and by, specially when two or three crops of paddy have been taken, the land will become fit enough for crops like gram, barley, arhar and juar. The best way of improving *usar* land after the initial stages is to cultivate it like other culturable land, of course a larger quantity of ordinary manure will be needed and paddy is the best crop to grow in the beginning.

If the owner of the *usar* plot wants to get something substantial out of his *usar* land, without any serious effort he may put a one foot high earthen embankment all round the area proposed for reclamation and if possible stop grazing by cattle altogether for two years. If even this is not possible he should at least put a stop to indiscriminate grazing and regulate it in such a way that no grass is grazed till it is nine inches or one foot high. In this way the unprofitable barren land will be converted into a good pasture land. Babul seeds may also be sown in the second or third year. These trees will make the pasture land shady and the Babul pods will provide concentrated food for cattle during the spring season. Over and above this babul wood and bark will bring good price in due course.

Wherever the alkali is due to excess of water it can only be improved by surface and subsoil drainage. If there are no *nalas* for draining of excessive water, wells might be dug to absorb water as suggested above

To sum up, all that is needed to reclaim our *usar* land is to (1) remove injurious salts, (2) make it friable, (3) make it well aerated by opening up the soil to a depth from 4 to 6 feet, and to (4) add humus to it. All this can be done very cheaply and successfully by following the methods described, above.

RAISING OF CALVES

By

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Introduction.—Agriculture is India's vital industry and cattle form its backbone. India also ranks first in the cattle population of the world. In 1935 the cattle population of the world was about 69 crores, out of which 18·8 crores, nearly one third of the total population, belonged to India (Wright, 1937, 1). Dr. Wright in his report on the Devedopment of the cattle and Dairy Industries of India says that India stands second in the volume of production of milk (Wright, 1937, 2). The total agricultural income of India is approximately Rs. 2,000 crores, out of this one-half, or Rs. 1,000 crores, is from cattle and cattle products, as shown below: (Wright, 1937, 3).

From	Milk and its product ...	Rs.	300	crores
,,	Hide	,,	40	,,
,,	Cattle labour ...	,,	300-400	,,
,,	Manure	,,	270	,,

The calf of to-day is the cow of tomorrow; so calves, not raised properly, do not become reliable and responsive cows. Permanent success in dairying also depends on the careful raising of claves. The starting point, therefore, of the breeder is not the dam but the calf.

Calves raised carefully are saved from becoming victims of disease. A desired herd can be built up, economically. High yielding animals can be produced, and individual history and pedigree sheet of the herd can be kept.

In every kind of undertaking, there are difficulties no doubt, but the difficulties are to be surmounted. The first difficulty in calf raising is the non-productive period with

no return on the investment. The second is the danger of losing calves by death and disease. The third and the last is, that some calves will prove to be inferior producers. These difficulties can be overcome if a careful selection of an individual cow is made, a good pure bred sire is used, heifers from the best cows are raised and disease is controlled (Herman, 1937, 1).

Care of the cow before freshning.—The programme of successful calf raising begins with the pregnant cow. The cow is a living machine for the production of milk. As constant work and no rest tells upon the ability of generating power of the machine, so also is the case in cows. Therefore, an opportunity must be given her to build up the reserve, which is exhausted during the milking period. She not only is allowed to recoup the reserve, but also to be prepared for the requirements of the uterus and subsequently of another embryo. A rest of about two months between lactation period, with a liberal rather laxative ration, containing plenty of legume hay, silage and concentrates will usually provide for this. "Cows producing 20lbs. or less milk daily may be satisfactorily dried off by the simple process of reducing the feed and ceasing all further milking. For heavy producers, the common plan of skipping milkings may be followed, at least until the production falls to below 20lbs. daily" (Herman, 1937, 2).

Care of the cow before calving.—Cows freshen normally from about 270 to 290 days after breeding (Shepherd, 1934, 1). Nearly two weeks before freshening, the cow should be separated from the rest of the herd and kept in the calving pen or in a quiet safe place. Approach of calving is indicated by a "relaxation of muscles, sunken appearance on either side of tail head, uneasiness and irritation with constant motion of tail, a swelling of vulva, fullness of udder and teats, white straw-coloured glairy discharge and ineffectual attempt to dung (Tweeds, 1931).

Care of calf at birth.—Cows that calve normally, usually get up immediately and begin licking the calf. If she fails to lick, the calf should be thoroughly cleaned up with dry straw or gunny bags. Occasionally the foetal

membrane may stick to the calf's nose and should be removed immediately to prevent smothering. "When a calf does not begin breathing promptly after birth, any mucus or membrane, should be removed from its nostrils, and attempt should be made to start respiration, by slapping the chest vigorously or by alternately compressing and relaxing it" (Morrison, 1937, 1). "After drying up the calf thoroughly, to avoid the danger of infection, the navel of the calf should be painted with tincture of iodine. The best way is to tie the navel with cat gut or twine about $1\frac{1}{2}$ inches from the belly, cut off the rest with a pair of scissors, and then saturate the navel with tincture of iodine." (Anonymous, 1933, 1). Alum powder dusted on the navel cut, will dry it up quickly. The udder and teats of the cow should be sterilized by wiping them with a cloth dipped in a mild chlorine solution, before the calf is nursed.

Nutrients requirements.—"In raising dairy cattle, special attention must be given to providing plenty of protein, protein of satisfactory quality, enough total digestible nutrients to permit normal growth, sufficient minerals, specially calcium phosphorus and common salt and liberal amounts of vitamin" (Morrison, 1937, 2.). Protein requirements for younger calves are proportionately higher than for cows. Nutritive ratio for calves 100lbs. in weight is 1 : 3·9 to 1 : 4·5 whereas for cattle 1,000lbs. in weight is 1 : 8·0 to 1 : 8·4—(Morrison, 1937, 3). It is also the same case with the amount of total digestible nutrients. Growing animals require more, because they require more energy. The variation is 1·5 to 2·2lbs. for 100lbs. in weight and 11·4 to 12·6 lbs. for 1,000 lbs. in weight (Morrison, 1937, 4).

Mineral requirements.—Deficiency in mineral matter results in malnutrition, rickets, bone disease, stunted growth and reduced constitutional storage. During colostral period there is no deficiency of mineral matter. After this, common salt, in addition to grain mixture, should always be supplied. A calf putting on about a pound and a half of body weight daily, should absorb no less than $\frac{1}{2}$ oz. of lime and phosphorus every day. Wheat bran and linseed meal are high in phos-

phorus and the inclusion of these feeds in grain mixture will prevent phosphorus deficiency. Bone meal is a source of both calcium and phosphorus So bone meal unmistakably should be added in the mineral mixture. Rock salt supplies sodium and chloride, necessary for the osmotic pressure of blood and digestion respectively. "Lime, as lime water should be given mixing with milk, 1oz. per head per day, until the calf is 3 to 4 weeks old. At that time lime not only supplies calcium but also delays the action of renin on milk and prevents hard curd formation, which is not easily digestible in the stomach." (Shepherd, 1934, 2).

Requirements of Vitamin.—"Vitamin A and D are of great importance in raising dairy cattle, for they often suffer from deficiencies of these vitamins" (Morrison, 1937, 5). Vitamin A is supplied with whole milk. Sunlight is sufficient for vitamin D. "It is generally accepted that the vitamin B is synthesised in rumen by bacterial action. So the concentration of vitamin B remains constant in cow's milk throughout the year" (Davies, 1936, 1). After the cessation of milk as a ration vitamin A should be supplied with carotin. "As a rule the greener the colour of the roughage the greater the content of vitamin A" (Shepherd, 1934, 3).

Colostrum.—"The colostral period may be regarded as the transition stage for the infant from that period, when it was nourished directly by the blood of the mother, to the subsequent period when it must depend on its own alimentary tract for its nutrition" (Davies, 1936, 2). The proteins of blood and why are almost identical. "Both blood serum and colostrum were found to contain antibodies, which by this means could be transmitted from the maternal blood to that of the offspring." (Davies, 1936, 3). Colostrum contains protein (albumin and globalia) up to 17·6 % whereas milk contains only 3·5 % (Herman, 1937, 3). The high acidity of colostrum is the main factor for the slower rate of coagulation by renin in the stomach of calf and thus helps for the digestion of milk easily. "The iron content of colostrum is approximately 17 times that of milk" (Davies, 1936, 4.) "Colostrum is very high in vitamin A" (Olson, 1939, 1). The high percentage of minerals of colostrum

e. g. 1·6 % (milk 0·7%) makes the new bodily organs of calf function well. "Various functions have been ascribed to this fluid amongst the most important being the purging or cleansing of the alimentary tract coupled with a disinfecting action, and the seeding of the intestines with the proper flora to deal with the milk later" (Davies, 1936, 4). Colostrum should be given just after birth. The amount depends on body weight, breed and physical constitution of the calf. In case the cow is milked before calving, the substitution for colostrum is to add castor oil and egg albumin in milk ration. For calves not receiving colostrum, 1oz. of linseed oil for 4 or 5 days, at night may be given (Sayers, 1937, 1).

Weaning.—Most of the owners and dairy farmers prefer to leave the calf with its mother for 3 to 5 days. "It is often stated that, with the cattle in India it is impossible to wean calves at birth, because the dam almost invariably goes dry and weaned calves are difficult to rear," (Macguckin, 1935, 1). It is true that forcible weaning and weaning in other lactation but first, may reduce and even stop milk yield. In no case, practically, a cow, on first calving should be affected, by having her calf weaned at birth. "With the removal of calf from the milking shed, the whole standard of calf management can be improved, hygiene of milking is simplified and accurate data on yields are collectable." (Macguckin, 1935, 2). Of course it is to be remembered that in both weaning and proper feeding, one cannot be said to be perfect without the other. Singh (1935) in his article "practical advantages of the weaning system," states all the advantages and disadvantages and concludes that 98·3 per cent cows and 97·7 per cent buffaloes, have been successfully weaned at all stages, from the first to the fifth calving. Our conclusion is that from economical and hygienical points of view, the calves should be weaned.

Teaching the calf to drink from the pail.—By instinct a calf stretches upwards to receive its nourishment. It must be taught to reach downwards to the pail. If kept hungry for 12–18 hours, calves are easily taught to drink from a pail. Generally a calf is backed to a corner and straddled. The calf is then allowed to suck the fingers of one hand held

in the milk, kept in front of it. When the calf begins to suck, two fingers are spread apart a little and the calf will draw milk between the fingers. This procedure is repeated several times, until the calf begins to nose around the pail and suck with its own accord. The bucket is held up or placed on a rack about one foot above the ground. The calf should not be permitted to gulp milk, which extends the aesophagus and some of the milk goes into the rumen, instead of going into the obomasum. The milk does not pass readily from the rumen and undesirable fermentation takes place, resulting in scouring and allied ailments. The result is an unthrifty pot bellied calf. Care also should be taken when taking out the fingers, that the calf may not suck air only, as this affects digestion by causing flatulence.

Feeding whole milk :—Milk is the secretion of mammary glands of mammals for the nourishment of their young ones. So the calf, though possible to some extent, to raise without milk, should be fed with whole milk, at least for 4 to 5 months. The temperature of the milk fed should be equal to the blood temperature of a cow *i.e.*, round about 100° F. It is better if the milk is pasteurized and cooled down to the required temperature. Pasteurization lowers the nutritive value of milk, no doubt, but the loss is insignificant as compared with the bad effect of bacteria. "Milk is easily digested and assimilated. Its nutritive value is 1: 3·9. It is high in minerals, specially in calcium and phosphorus. It contains fat soluble vitamin A and D. It is dificient in iron, copper, manganese and magnesium, but this does not cause any harm, unless animals are continued on milk as an exclusive diet during a far longer period than normal (Morrison, 1936, 6). Foam in milk in large quantity causes the animal to bloat, but in small quantity it does not have any bad effect. A new born calf should receive from 6 to 8 pounds of milk a day or about 10 per cent of its weight for the first week or two (Olson, 1939, 2). As the calf grows the amount increases until 8-1 lbs are given daily. At least for the first week the calf should be fed with its own mother's milk thence forward herd milk may be given. "General milk of the herd should be fed not the stripping. All calves should be weighed at birth and their feeding is

regulated according to their weight as per chart given below" (Sayer, 1937,2).

Wt. of Calf at birth.			Quantity of milk fed.
under 40 lbs.	...	...	5-5½ lbs.
40-45 „	...	...	6-6½ „
45-50 „	...	...	6½-7 „
50-55 „	...	...	8 „

Feeding skim milk.—At about 1½ to 2 months of age the calves are started feeding on skim milk. But it should be substituted gradually with whole milk. The amount varies from 0·5lb. to 1·5lbs. according to the constitution of the calves and method of raising.

Feeding grain mixture.—Grain mixture supplies the dificiency of energy due to the low fat content in skim milk, and adds to the mineral requirements of the calf as well. Wheat bran is a good source of iron and phosphorus. The mixture differs according to climatic conditions of the country. In Nepal, the grain mixture given to the calf consists of 2 parts maize flour, 1 part barley, 1 part soybean, and 1 part *tori* (rape) oil cake. Either it is fed in the form of dilute gruel, or fed in the form of pills by inserting them with forefingers up to the gullet of the calf. This is fed twice a day even during the colostral period. The amount of mixture varies with the size and age of the calf.

Feeding roughage.—"Since green coloured hay is the richest source of vitamin D among common feeds and is also high in vitamin A, it is very important that calves have access to good hay as soon as they will eat it" (Morrison, 1937, 7). At about 4 weeks of age the calf's rumen is fully developed to digest half a pound of hay, usually by the beginning of the 2 or 3 weeks of age, a handful of hay should be placed before a calf each day in a hay-rack or in a clean place. "From the stand point of the amount of protein, calcium, and vitamin A and D supplied, leafy, fine stemmed legume hay is the best for calves" (Morrison, 1937, 8). Silage should not be fed too early, for it may cause more trouble

from scours (Morrison, 1937, 9). Silage given should be free from mould and not too acid.

General Management.—Calves should be provided with clean, well lighted and airy stalls. All feeding vessels and water buckets, should be well cleaned and sterilized before use. Water should be given only after the second week. The feeding schedule should be followed closely. It is better to keep the calf always a little hungry than to overfeed. They should be often brushed in order to do away with lice and ticks and to keep the skin clean. The calves are allowed to lick salt after feeding on milk. It saves them from licking each other or the wall and bringing digestion trouble. If possible they should be muzzled up to $2\frac{1}{2}$ months of age when not being fed. This will prevent them from licking and consequently from getting its bad effect. Personal examination of each and every calf is the most essential thing. Special ration may be given to that particular animal, which is indicated by birth weight, by the ability to transmit high producing characteristics of the sires, and by the yielding capacity of the dam.

Dehorning.—As a rule calves should be dehorned at the age of one to two weeks. The most satisfactory method is to use caustic potash for the purpose, as it kills growing horns. First the hair is clipped from a small area around the horn buds. Then encircle the clipped area with vaseline to confine the action of caustic potash to the area of horn and thereby to prevent it from running to the eyes. Finally the horn buds are rubbed with a caustic-stick, till the outer scale comes off exposing white tissues The calves are then protected from rubbing their heads against the wall or poles. Dehorned cows are easier to handle and are more uniform in conformation. They can do no damage to each other. The percentage of udder injuries in the herd is also less. Dehorned cattle however do not fetch good price or prizes, as well.

Removing extra teats.—Rudimentary teats often appear on the udder of heifers. Occasionally rudimentary teats appear as a part of the main teat and are of a considerable annoyance in milking. Such teats are hard to remove and require a Veterinary doctor. But an ordinary extra teat is

removed by simple methods. One of these methods is to tie tightly with thread or rubber band or horse hair, around the base of the extra teat. Within a week or two the extra teat will drop off. Another effective method is to cut with sharp scissors and apply iodine solution in the wound (Herman, 1937, 4).

Marking for identification.—There are several methods of marking cattle for identification *e.g.* (1) tattooing the ear, (2) notching the ears, (3) "branding with hot iron, (4) branding with brandem-al solution" (S. Cox and Lazarus, 1937), (5) tagging in the ear, (6) leather strap or chain round the neck, (7) halters with number plates attached, (8) clipping of the hair of tail in a certain fashion, (9) various colouring matter in the bodies of animal, and (10) photograph in some herd (Herman, 1937, 5). To permit easy identification each calf should be plainly marked. It is necessary in pure-bred herds and herds of considerable size even if of made up grades.

Common Ailments of Calves

Scour.—The most common disease in calves is scour or extreme looseness of the bowels. Its causes are over feeding, sudden change in quantity, and feeding milk too rich in fat. Its precaution is to isolate the calf without the milk for a day. A pint of lime water may be added to milk at each feeding. Castor oil emulsion should be given thrice daily.

Lice.—These are common in winter and are often present, specially round the muzzle, eyes, withers and along the line. The treatment consists in the application of raw *tori* oil, raw linseed oil or 3 % coaltar. Any of these should be applied two or three times repeatedly at weekly intervals.

Ring Worm.—This infection of the skin is indicated by round spots of rough skin, devoid of hair. The spots should be washed with soap water, scraped to remove all scaly materials, and treated with tincture of iodine and iron in equal parts. Some prefer to use kerosine oil and petrol mixture too.

Calf Pneumonia.—It causes a heavy loss in calves. It is caused by bacteria, but the susceptibility of the animal is influenced greatly by bad management, *e.g* over-crowding, dampness, poorly ventilated quarters, insufficient bedding, concrete floor, etc. The disease is characterised by profuse discharge from nose, heavy breathing and high body temperature. Such calves should be isolated, blanketed, placed in dry well-bedded pen free from drafts and given access to slean water A purgative of castor oil with mineral oil chould be administered.

Lead Poisoning.—Paints containing lead should never be used on building or fences. Such paints when consumed in any appreciable quantity are poisonous and result in the death of an animal.

Scale of Calf Feeding (special) [*Sayer, 1937, 3*].

Age in weeks.	Milk lbs.	Skim milk lbs.	Grain mix lbs.	Salt oz.
1— 2	8	..	..	..
3— 4	10	..	..	..
5— 8	12	..	1	1
9 - 12	14	..	1	1
13 - 20	10	2	1½	1
21—28	8	4	2	1
29 36	6	6	3	1
37 40	4	6	4	1
41—44	2	6	4	1
45—48	..	4	4	1
(Ordinary)				
1— 2	8	..	..	..
3 4	10	..	..	..
5— 8	12	..	½	1
9—10	8	2	1	1
11—12	6	4	1	1
13—16	4	4	1½	1
17—18	2	6	2	1
19—20	2	4	3	1
21—24	..	4	3	1

Feeding Schedule for Calves. Agricultural Institute, Allahabad Dairy.

Age in weeks.	Whole milk lbs.	Skim milk lbs.	Grain mix lbs.	Grass hay lbs.	Silage lbs.
1	2·5	..	..	..	..
2	2·5	..	0·25	0·5	..
3	2·5	..	0·25	0·5	..
4	2·5	..	0·5	1	..
5	3·0	..	0·5	2	..
6	3·0	..	1	3	..
7	3·5	..	2	4	..
8	3·5	..	2	4	..
9	2·5	1·0	2	6	.
10	2·0	1·5	2	6	..
11	2·0	2·0	2	8	2
12	1·0	3·0	2	8	2
13—20	..	4	3	10	3
21—24	..	5	4	12	4

The above schedule is per feeding. At least for 2 weeks calves it should be fed thrice daily. Rock salt is given in the stall. Colostrum is given for three days. During the first week calves are fed with dam's milk only.

N. B:—

Mineral mixture		Grain mixture	
Bone meal	49·8%	Juar	30%
Slaked lime	16·6%	Ground barley	30%
Salt	33·3%	Wheat bran	30%
Potassium idodide	0·03%	Linseed cake	10%
		Mineral mixture	2%

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GRAPE FRUIT

The grape fruit, or shaddock, possesses very much the same properties as the orange, lemon, lime and citron. It is nearest to the lemon in medicinal value, but has, in addition, the advantage of being more palatable when ripe. It can be eaten like an orange but is slightly bitter in place of being sour like the lemon or sickly-sweet like the ripe orange.

CROP IMPROVEMENT BY HYBRIDIZATION

BY

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One of the ways of effecting improvement in crop plants is, as already pointed out in a separate communication of the series, by selection. The other alternative way towards the same end is by means of hybridization. Resort to this latter method is generally taken when selection has failed to produce the desired effect, or when the variability in the material under consideration for improvement is so low that the need for the presence of greater variability is felt. In other words, hybridization is employed in order to create variability for further selection. Some workers are apt to give primary consideration to hybridization, and employ it where simple selection will be equally effective, but it should be realised that since selection is the process which mainly works, hybridization is only a means to make it effective.

Principles governing the inheritance of characters after hybridization were discovered in 1900 by Mendel working with peas. With the fuller understanding of the laws of inheritance or Genetics, as it is called, it is much easier now to understand the way in which hybridization acts.

Necessity for Hybridization.—The real necessity for hybridization arises when selection has failed to produce the desired variety. There are often more than one attributer which go to make a variety successful. For example, an ideal variety in cotton for the United Provinces will not be only that one which has a good ginning percentage, but its fibres should also have an appreciable length and smoothness Although selection in the local indigenous cottons may solve the difficulty of low ginning percentage, but the other difficulties will not be solved as the material has been so much

selected and re-selected for increased ginning percentage which is due to increase hair-weight involving coarseness, rather than increased lint area on the seed coat, that the genes of increased length and fineness are not there any more. The latter characters also are not sufficiently variable to make selection effective. For these reasons Hybridization with a view to increase the variability of the above characters to make further selection effective has got to be resorted to.

The other reason for which hybridization has to be employed is the ever changing market demand resulting in the evolution of a type quite different from the original material of a tract. A type cannot be evolved in the ordinary way, as the material has gone much ahead in the process of selection and some of the characters are fixed in a way that very little chances of success are left. That is to say, a new variety must have in combination the good characters of several other varieties, which have to be synthesised according to the demands prevalent. An example that may be cited in this connection is the evolution of a heavy yielding, disease resistant, erect, fragrant, fine-grained, and easy-to-thresh variety of paddy, which at the same time is suited to the climatological conditions of the tract.

Hybridization therefore is a tool in the hands of a breeder to be used with caution in cases where it becomes necessary to introduce new characters in his types especially when a search for that particular character has proved fruitless

The role of hybridization. Prior to the discovery of Mendelian inheritance the behaviour of the hybrids was not known for certain. Mendelian inheritance has provided an interpretation of the behaviour of the hybrids. The hybrid in the second generation when selfed, produces a vast array of forms, depending upon the number of factors for which the parents are different. This instability of the hybrids affords a good chance for the breeder to select his types either superior or different from the parents differing in the presence or absence of the characters desired. The opportunity thus afforded for suitable selections often leads to disappointment as year after year the hybrids show remarkable instability either reverting to the parental forms or presenting difficulty in the

fixation of a type. Mendelism has provided an explanation for all these behaviours, and guides the breeder towards a way of overcoming this difficulty. The complete difficulty has however not been overcome, and it is due more to the complex nature of the problem rather than to the shortcomings of the method. The characters which attract the attention of the breeder are mostly economic, and these are now known to be governed by numerous factors (genes) sometimes as many as 300 to 400, at least in the case of yield, and it is due to this that his problems get complicated and difficult if not impossible to analyse. The difficulty of fixing a type after years of study may be due to this multiplicity of the factors involved in the expression of a character together with the intricacy with which a character is bound with another undesirable character.

Hybridization in spite of the above difficulties has played an important role in the evolution of economic crop plants. Numerous examples can be cited to substantiate the above assertion. Some of them are mentioned to show the extent and the nature of the problems solved by the method of hybridization.

One of the earliest and the most outstanding examples of the achievement by hybridization was the production of Marquis wheat in Canada. It was the result of a cross between Red Fife and Hard red Calcutta wheat. The accidental introduction of Red Fife in Canada in 1842 and the timely recognition of its worth resulted into its general cultivation replacing thereby all the other wheat varieties.

These wheats were susceptible to early autumn frosts and consequently they suffered great losses due to cold A wheat with the quality of Red Fife but with shorter period of growth was greatly in need. The early ripening Hard red Calcutta wheat appeared a suitable parent to use, and Marquis was the result. It is ready abcut a week earlier than Red Fife, out yieids the Hard red Calcutta, and is good in milling and baking qualities, and within twelve years it covered a vast area in the United States of America.

The development of Marquis in America had its effect on English agriculture. England was only producing soft

wheats at that time, and consequently large quantities of hard American wheats were imported, since the cultivation of American wheat was not profitable in England. Gradually the area under the high yielding English wheats in England fell considerably. A way out of the impasse was found by Biffen when through hybridization of Red Fife and some of the English wheats Yeoman 1 and 2 were produced, which had the qualities of Red Fife and the yield ng capacity of the English wheats

The breeding problems tackled by hybridization are more complicated than those mentioned above. One of these is the breeding for disease resistance. The complication in the case of diseases caused by fungus are due to the presence of different physiologic forms of the fungus.

A wheat variety may be immune to one form, but may not be immune to another. The physiologic forms may be different from place to place and a variety resistant at one place may be susceptible at another. It is not so easy to combine the resistance to the different physiologic forms of fungi in a variety. The snag of the whole problem is that different physiologic forms may be produced from time to time. Even under circumstances considerable success has been achieved in the evolution of disease resistant forms. Biffen's Little Jess, Mc Fadden's Hope and Broach desi 8 cotton may be regarded as landmarks in breeding for disease resistance.

Remarkable advances have been made in India too, to improve its crop plants. Imperial Pusa 4, 12, and 52 wheats are some of the finest achievements in breeding for disease resistance.

Several new varieties of cotton as Banilla, C402, Jaiwant, and 4F Punjab-American cotton, etc., are other examples of improvement by hybridization.

Breeding methods.—It is needless to emphasise that the breeder should have a clear cut picture of the type he wants to produce, and its relation to the agricultural and climatic conditions of the tract, before he actually takes resort to the method of hybridization. Since the process involves much time and careful work, it is likely to be a laborious one and expensive. It generally takes 8 —10 years or even more to

produce a type. The next step is the careful choice of the parents, as much of the success depends upon this preliminary selection. The parents themselves should also be pure, and it is always safe to test the parents for purity by trying them for a few generations and watching their behaviour. The general rule followed in crossing is to always cross those parents which possess the maximum number of factors which one would like to be present in a type.

The process of crossing first consists in discovering the time when the reproductive elements of the parents are ready to effect pollination. In case any trouble regarding it is left, necessary care is taken either to hasten the formation of pollen by artificial means, such as light and temperature, or by adjusting the sowing time of the parents in a way that both the parents flower at the same time. In some cases it may even become necessary to preserve the pollen or to make the stigma receptive artificially. After the discovery regarding the time at which the germ cells are mature, the next step is the emasculation which consists in removing the male parts or anthers from the flowers of the female parents taking care that the whole thing is done in as clean and delicate a manner as is possible. Jerking or injuring the flowers results in failure of fertilisation. After emasculation the flower is covered by means of a paper bag to insure against any accidental introduction of foreign pollen by natural agencies as wind and insects. At the time when the flower is emasculated unopened buds of the male parent are bagged insuring against the contamination of the pollen by aforesaid natural agents. The pollination of the emasculated flowers is accomplished by the pollen of the bagged buds of the male parent at a time when the stigma is known to be receptive, and the flower closed again by paper bag. The shoot bearing the treated flowers should carry a tag bearing the necessary details of the parents, date of operations, etc.

Certain symbols commonly used in hybridization work may be explained here. Parent generation is represented as P_1, the first hybrid generation as F_1 and the second hybrid generation as F_2 and so on.

The plants from the hybrid seed or the first generation are looked after with great care, for any mishap may mean

the retardation of the work by one year. The notes taken of the various F_1 plants for their comparison with P_1, F_2, and F_3 are of great value in discovering the mode of inheritance. Sufficiently large F_1 should be tried as it gives a greater assurance of the results obtained, being based on a larger sample The case is comparatively easier where a large number of seeds are produced at a single crossing as in the case of cotton and linseed, but in cases where a single operation gives only one seed the case is different and needs greater work in crossing. The seeds from F_1 plant give rise to F_2 generation. The seeds from different F_1 plants should be sown separately to enable comparison of different F_2 families. Whereas F_1 generation is more or less homogenous, F_2 generation is comparatively very heterogenous: in fact it is the most variable generation of all. Breeders of the past were quite familiar with the variability produced by the breaking up of the hybrid. This variability opens up great possibilities for selection as in this generation the segregation and recombination of the factors going in a cross takes place. For selection to be effective it is imperative that the variations in the F_2 be analysed, and therefore the notes for the characters under selection are carefully taken for all the plants in the F_2 generation. To make a valid estimate of the variability of F_2 generation it is necessary that this generation should be liberal. From the seed of the different F_2 selections F_3 families are raised and notes for every plant taken to test the variability and to confirm the mode of inheritance advanced to explain the F_2 results.

In case the F_3 does not conform to the behaviour of the F_2, the latter can be corrected. The attempt of selection in F_3 and in later generations is to isolate true breeding forms showing the desired combination of the characters for which the cross was made. The magnitude of the work can be cut down to the absolute minimum from F_4 onwards by rejecting families which are likely to split up. The success of the show depends upon efficient discards which would save time and labour. Keen insight and thorough familiarity with the material is needed at the time of making discards; and if proper discards have not been made there is every likeli-

hood of throwing away the valuable material. When the desired forms have been isolated they are rapidly multiplied, and an eye is kept on the behaviour of these forms and careful notes taken on segregations if any. The pure breeding forms are then tested in field trials against the parents and the standard variety or the local variety to estimate the utility of the hybrids, and if found satisfactory, are finally released for general cultivation.

Difficulties in Hybridization.—Besides being time-consuming the process of hybridization is a chance shot, as the desired combination of the different characters in a type may not take place on account of several reasons, as multiplicity of factors and a close linkage, etc. The difficulty becomes all the more acute, when it comes to deciding as to which parents if used will give the most profitable result. The criterion of crossing these parents which have the maximum number of characters that are desired in a cross though sound, does not eliminate the chance factor from such an enteprise regarding the most profitable results, especially when there are several types having the aforesaid quality. The difficulty has only very recently been overcome by Fisher who advocates the use of Diallel method of crossing as he calls it. The method consists in crossing a parent with a number of other parents and comparing the variability of the first generation of all such crosses. The combination of the parents which raises the mean value of the particular character highest in F_1 is the one most suited for further study The method is particularly useful in the case of quantitative characters which are governed by a large number of factors such as yield. And the combination which raises the mean value to the highest has naturally the maximum aggregation of the yield factors, and likely to yield better results than those cases where such estimation of the performance of a character which has the maximum accumulation of factors in a generation as F_1 is absent.

Difficulty also arises in cases where attempts at the synthesis of a type involves wide crosses such as Upland and Egyptian crosses in cotton. The result of such a cross is that the segregates are no better than either of the parents

due to the disturbances in their genic balance. Nothing better can illustrate the state of affairs as Harland's analogy of trying to produce a new car from the parts of two different makes of cars. Just as there will be trouble in the adjustments of the parts of the two cars, as they will not fit, similarly, in wide crosses, the different genes will not combine and will result in unbalanced hybrids. What can be done, of course, is that some parts can be changed, for example the carburator of one make if changed; with that of the other, the performance is likely to be improved. Similarly in such cases gene or genes could be transferred from one type to another, and this method is known as continued back-crossing. The F_1 in this method is always back-crossed to the parent whose genes are desired to be transferred in the progeny of the cross. This method besides reducing the variability of hybrid to the minimum has an advantage that it yields quickest results. Two or three or at most four back-crosses are needed to achieve the goal.

Besides the minor troubles of the time of receptivity of stigma, and the wide difference in the maturity of the reproductive organs of the two parents referred to already, and which can be overcome by slight adjustments, difficulty is experienced due to non-crossability of the two parents, as they differ fundamentally in their germinal constitution or the number of chromosomes. Such crosses if successful often exhibit varying degrees of sterility, so much so that the hybrid may be completely sterile, and the only chance of success remains in polyploidy, which consists in doubling of the chromosomes restoring the fertility thereby, and producing a new type. Two kinds of polyploids, auto and allo polyploids are met with, the former when the chromosome doubling takes place in the somatic cells as in the case of *Primula kewensis*, and the later when the doubling takes place in the germ cells as in the case of *Raphana brassicae.* Recently it has come to light that by means of chemicals such as colchichine, polyploidy in the hybrids can be induced; and Belling has reported much success by this method.

Physiological reactions in the style affecting the growth of the pollen tubes exert a discriminating influence upon the

capacity of fertilisation of the different pollen tubes, and produces a state of affairs termed as certation. Under the circumstances the pollen of a parent can fertilise the ovule of another parent only in one direction, that is to say that the pollen grains will be effective in a particular style, and will be useless in a style whose physiological reactions are inhibitive to the growth of the pollen tubes.

Sometimes the climatic conditions lay obstacles in the process of seed setting. This is exemplified in the case of sugar cane breeding in India, because while artificial fertilisation in Coimbatore (Madras Presidency) results in viable seeds, the process fails to produce seeds in the Indo-Gangetic plains whatever sugar cane varieties are used.

Lastly due to the multiplicity of the factors a desired combination may not take place in practice. The theoretical possibility is though present there, but the parents are perhaps differing in so many factors that the chance of getting at the desired combination is one in a million or even less. It is also impracticable to grow a huge F_2. Under the circumstances the best thing is to continue selection for a number of generations.

The above-mentioned difficulties should not be discouraging, as inspite of such difficulties valuable results have been produced. The method has been followed up till now in the absence of any better method. With man's quest to unearth the secrets of nature better methods are bound to come and they are coming.

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DISEASES OF PLANTS AND AIDS TO GROWTH*

VARIED RESEARCH PROJECTS UNDERTAKEN UNDER DR. WILLIAM CROCKER OF WILLIAM BOYCE THOMPSON INSTITUTE.

Science tackles the mysteries of plant life and growth at the Boyce Thompson Institute for Plant Research, which was established 14 years ago by the late Colonel William Boyce Thompson, copper king and philanthropist.

The founding of the Institute represents the welding of two great interests of Colonel Thompson, his love for growing things and his devotion to science and research as a means of making life more worthwhile for mankind.

The Boyce Thompson Institute for Plant Research was born out of the Colonel's expressed desire "to get at the real bottom of the phenomena of life processes." He visioned the Institute as his contribution "to the future of mankind."

On the recommendation of Professor John M. Coulter, head of the University of Chicago's noted Department of Botany, Dr. William Crocker, an associate professor of plant physiology, was selected as managing director.

According to the first principle of its organization the Institute has attacked practical problems in a fundamental way. A description of some of the projects undertaken will show to what extent the results have contributed to practice and to science.

SEED STUDIES

An exhaustive study has been made of the germination and storage of seeds. Horticulturists who have undertaken to grow a great number of wild plants from seeds know the difficulties arising from delayed germination and have also been impressed by the rapid degeneration of certain seeds. In this project, methods have been worked out for getting reasonably prompt and complete germination of more than

*Extract from an article in *The Herald Statesman*, Yonkers New York, U.S A.

100 different kinds of seeds that give great trouble to horticulturists, breeders, conservationists, seedsmen, foresters, and others. The seeds studied fall into five or six categories as to cause of dormancy or methods of treatment to overcome it.

Some seeds remain ungerminated in most soil for years because the coats prevent absorption of water. Hard-coated seeds are especially common in the legume or pulse family. The gardener learns this if he attempts to grow wistaria, Scotch broom, locust, Kentucky coffee-bean, or many other legume seeds. The farmers often have trouble with clover, alfalfa, and other forage legumes. Several methods have been developed for overcoming the delaying effects of hard coats such as filing, hot water or sulphuric acid treatment, and passing seeds through specially designed abrading machines.

Many seeds of the temperate zone need a period in a moist medium at a low temperature to after-ripen them for germination. In nature, Winter supplies the low temperature and prepares the seeds for germination in the Spring. The best stratification temperature varies for different kinds of seeds from 33 degrees Fahrenheit to 50 or 55 degrees Fahrenheit, and the time from a month to nearly a year. Amongst seeds requiring low temperature stratification are many rosaceous forms, dogwoods, and forest tree seeds including some conifers as well as seeds of many alpines, temperate zone wild flowers, and water plants.

'Two Year Seeds'

Every nurseryman knows that many seeds when planted in the Spring will not produce seedlings until the following Spring and some of the seeds of a given planting may produce seedlings the second or third Spring after planting.

There are at least two types of so-called two-year seeds. In the first type bacteria and fungi partially eat away the thick coats during the warm weather of Summer so that the embryos get an adequate supply of water and oxygen for after-ripening during the cold of Winter. Amongst plants

with such seeds are the common snowberry, silver bell tree, hawthorne with heavy woody coats, basswood, and most Cotoneasters. These seeds can be forced to grow the first Spring after maturing by removing the hard coats or partially eating them away with sulphuric acid and stratifying at low temperature to after-ripen the embryos.

In another type of two-year seeds the root grows during the first Summer but the top will not start until the epicotyl or bud that forms it has been exposed to a low temperature for a while. Amongst plants that produce such seeds are peonies (especially tree peonies), colder temperate zone viburnums, some lilies, Solomon's seal, and others. Seeds of this type can be made to produce seedlings the Spring after harvest by planting them in flats in a greenhouse soon after harvest and exposing the flats to low temperatures for a month or two in the Spring after the root system has formed.

These studies are still being vigorously pursued in co operation with workers in all parts of the United States and Canada who meet germination difficulties. Just recently a method has been developed whereby the viability of even the slowest germinating seeds can be determined within a week or two. Extensive studies have also been made on the storage of various short-lived seeds giving trouble to the workers mentioned above. In ordinary storage delphinium degenerates to a marked degree in one-year. With good storage conditions no degeneration occurs even after 11 years, with the experiment still running. Sealed storage at a temperature of about 41 degrees Fahrenheit has proved good for retaining the vitality of a number of flower, vegetable, and tree seeds.

Hormonal Regulation of Plants

Much has been written during the last 50 years about the mysterious forces which regulate growth and development of plants. The results of recent investigations take away some of this mystery and indicate that, as in the animal kingdom, growth and maturation are regulated by chemical substances (hormones) produced by the organism itself. Such

substances can be extracted from plants and animals and when reintroduced into normal tissue, hormone-like responses occur. In fact we can synthesise effective chemicals in the laboratory and when these are applied to plants the responses are very much like those induced with natural hormones. And, as with animals, a single chemical compound produces several different effects on the plants. For example, naphthalene acetic acid causes acceleration of growth, influences rate of growth, causes tropisms (bending of stems, leaves etc.), swelling of tissue, proliferations, and induction of adventitious roots. The later response brings about considerable interest in the use of hormones to aid vegetative propagation of plants. Some 30 of these chemical compounds have root-inducing power when applied to plants in various ways. Stems, leaves, roots, and even flower parts can be induced to form roots. The most important practical application is the chemical treatment of cuttings (slips) which are used for vegetative propagation of plants. Easily rooted cuttings can be greatly accelerated by chemical treatment and difficult types can be induced to root. In many cases, this new method of propagation is sure to displace the older methods of grafting and budding. The new method is easy to follow: use a portion of a stem for the cutting and handle as usual except for the chemical treatment which calls for immersing the basal ends in the solution before planting in the rooting medium. The most effective chemicals for rooting are naphthalene acetic acid and indolebutyric acid which are sold under trade names.

The early work in this laboratory involved illuminating gas and unsaturated carbon gases (ethylene, acetylene, propylene, and carbon monoxide) which were known to have peculiar effects on plants. One part of ethylene to a million of air accelerates growth on the upper side of leaves of tomato plants, causing them to grow downward (epinasty). This response is useful for detecting illuminating gas or other escaping gases in houses and greenhouses. While using carbon monoxide gas it was found that in addition to causing epinasty this gas had also root-inducing power. This was the first pure chemical ever reported to have the capacity to induce adventitious roots on plants. Later, ethylene,

acetylene, and propylene gas were found to have similar effects. Such work continued until the more complex and more effective root-inducing chemicals (solid and liquids) were located. Strangely enough, the simple gases and the complex crystalline substances mentioned above all induce similar hormone-like responses.

A study of these responses gives us a better understanding of natural regulation of growth and development of plants and also suggests several practical applications.

Light Effects

The Institute has had since its inception a project on the growth of plants under controlled conditions of light, temperature, humidity, and carbon dioxide concentrations.

The flowering response of plants is dependent mainly upon day length and temperature. The limits of toleration for a wide variety of plants have been determined in both the "constant light rooms" and the greenhouses where extra light is available at night. The day-length also has an effect on the growth of plants in other respects and careful measurements of weight and chemical composition have been made in an effort to understand the flowering responses of plants. Several plants have been grown for more than a year under continuous artificial light furnished by sodium and capillary mercury vapor lamps. Neither the ultra-violet nor infra-red but only the visible spectrum is found necessary for plant growth. Artificial light sources with high ultra-violet output are injurious and frequently burn the leaves.

As a result of this work a practical greenhouse has been built in which it is possible to bring many Summer blooming plants into flower in the Winter time when the limiting factor is the day-length. Extra lights is provided at night by means of Mazda lamps which are made to heat the house as well. They make good heaters since 90 per cent of their energy is given off as heat and only 10 per cent as light. They are neverthless an expensive source of heat so the house was built to conserve it. The walls are heavily insulated and the glass area is cut to a minimum.

Since the house is heavily insulated and is practically air-tight, radiation from the sun keeps it warm during the day and, of course, provides the necessary light. At night the sun's energy is lost and the house tends to cool. The lamps are operated by a thermostat so that they are controlled by the heat requirements of the house. Control of the total day length was accomplished by determining the number of lamps required to keep the house at the proper temperature when operated for the time desired with an average outside temperature. An extra supply of carbon dioxide is essential to the operation of this house since there is a relatively small exchange of air.

Investigation of Viruses

In 1892 the agent responsible for tobacco-mosaic disease was found capable of passing through the pores of a filter which held back the usual microscopically visible forms of disease, such as bacteria. Since the discovery of this first filterable virus of plants, investigators have been probing into the nature of filterable viruses. Are they chemicals or organisms is the oft-debated question! It was shown at Boyce Thompson Institute that tobacco virus could be purified by methods usually employed in the purification of enzymes. Also, the serum technique, widely used in medicine, was found applicable to the study of this virus. The juice extracted from a virus-diseased tobacco plant when injected into a rabbit produces an antiserum that will neutralize the virus and render it non-infectious. The antiserum also reacts with the virus to form a precipitate, when the two are mixed in a tube, which is most useful in diagnosing the disease as well as in identifying unknown host plants or plants which are dangerous carriers of the virus, but in which the usual mottling symptoms of the disease are masked. More recently, following the crystallization by Stanley of Rockefeller Institute of a protein possessing the properties of tobacco mosaic virus, crystalline plates occurring in nature in the living diseased cells of plants affected with this virus have been linked with Stanley's crystalline material obtained through purification of the expressed virus.

PEACH YELLOWS

The century-old mystery of peach yellows has been solved by workers at the Institute. This disease, said to be the most important virus disease of the peach in Eastern North America, is transmitted from diseased trees to healthy trees by means of a shy little insect known as the plum and peach leafhopper, that feeds by sucking the sap from the tender branches during the Spring and early Summer. The leafhopper that transmits this disease feeds principally on wild and cultivated plum trees, but also feeds on peach trees. Unlike most species of leafhoppers, both adults and young feed on the twigs and are only occasionally observed on the foliage. They run rapidly over the twigs and the adults do not fly when approached nor do the nymphs hop as is the usual habit of leafhoppers, but seek concealment in the forks of the limbs or on the opposite side of the branch from the observer. The insect passes the Winter in the egg stage in slits beneath the outer bark of plum and to a lesser extent in peach

The eggs hatch during the latter part of May and the early part of June. The nymphal period requires from 21 to 35 days under field conditions. The adults appear from the middle of June until the first week in July and may be collected in the orchard as late as the middle of August. That the plum and peach leafhopper is not merely a mechanical carrier of peach yellows has been shown by the fact that the insect is incapable of transmitting the disease until an "incubation period" of approximately two to three weeks has elapsed. Motile intracellular bodies 1—25,000 of an inch in length, discernible only under the highest powers of the microscope, have been discovered in the salivary glands and the wall of the intestine of infected leafhoppers. Similar intracellular bodies have been observed in peach tissue from trees affected with peach yellows.

The disease is characterized by premature ripening of peaches from a few days to two weeks in advance of healthy fruit of the same variety, and also by the presence of sickly yellow upright shoots which appear on the trunks and branches of the peach trees. The removal of the diseased

trees as soon as they are discovered in the orchard, the removal also of wild plum trees from the vicinity of peach orchards, and the discontinuance of the practice of growing peach and plum trees in the same orchard, are the only remedies known that can be used in general horticultural practice. Now that the insect which transmits peach yellows is known, it is hoped that a more satisfactory control may be developed.

Microchemical Methods

Microchemical methods as used in the study of problems in plant physiology and pathology consist of chemical tests made on fresh sections of tissue and observation of the reaction with the microscope. With the aid of these methods studies have been made of changes in the cells due to metabolic processess and of the development and structure of the cell wall

Absorption of the mineral nutrients and their distribution throughout the plant have been followed. The conditions necessary for the reduction of nitrates in the plant and the formation of animo acids have been studied.

Studies of the progressive changes in the cells and the chloroplasts of tomato plants, inoculated with tomato virus, have been made from the time of inoculation up to full development of the disease. The effect of cranberry false blossom has been studied, and other virus diseases observed.

Bananas and potato tubers, treated with carbon dioxide and other gases in another project, were studied to note the effect on the starch grains in the cells.

A study is now being made of the green choloroplasts in the leaves and of the colourless leucoplasts in seeds, bulbs, and tubers with the hope of finding the method of development of the highly organized starch grains and their internal structure

Storage of Lily Pollen

Lilies had been under study at the Institute, chiefly in connection with the diseases affecting them, since 1927. By

1935, an excellent collection of healthy plants of many species had been built up which offered an opportunity for the breeding of desirable new forms by cross pollination. If hybrids between the early May-blooming forms, the intermediate, and the late August lilies were to be produced, it was necessary to work out methods for conserving the ability of the pollen to function longer than the two weeks it ordinarily retains life in the air. The development of several successful methods makes it now possible to use pollen stored a full year, for the production of seed which grows into strong plants. Many different combinations of pollen and seed parents have been tried Germination of the seed produced gives seedlings which are being grown to the flowering stage, a process usually requiring at least two, and often more years.

The conditions for successful storage of pollen of Amaryllis have also been determind. The application of similar methods to pollen of other ornamental plants is in progress.

SOILS.

A critical study of the methods in use for the determination of the amounts of readily available elements of plant food in soils has revealed wide discrepancies in their application. They have been found to be misleading in many instances. It is apparent they have been utilized for exploitation purposes, or for the promotion of the sale of some products.

One of the outstanding soil management problems over wide areas consists of the incorporation and maintenance of sufficient amounts of organic matter in soi's Some of the materials in the natural condition are not suitable either on account of their physical structure or chemical composition. Researches reveal that they may be processed successfully in the soil or before they are applied to it. When this is done properly various fertilizer materials bring much greater returns as evidenced by increased yields and improved quality of the plants grown in the soil.

CARBON DIOXIDE STUDIES.

The Institute has conducted projects in co-operation with industrial firms on much the same basis as those

Colonel Thompson supported at Mellon Institute. In one case it was necessary for a progressive company to know the concentrations of carbon dioxide that fruits, vegetables, and flowers would withstand without injury during a period, of refrigeration with Dry-Ice. During the course of the investigation many points of theoretical interest arose and after the practical problems were satisfactorily settled, the Institute assumed complete financial responsibility for the continuation of this work During the study of the more fundamental aspects of the effect of carbon dioxide on plant tissue, many theories of long standing have been refuted and much information has been obtained in respect to the complexity of the living processes even in plant tissue.

Carbon dioxide may not only be used as an essential gas in the formation of sugars in plants, but it may also control in plants, as it does in animals, many of the fundamental metabolic processes so essential to living things This gas, which is chemically an acid, will bring about changes in plant tissue whereby the tissue becomes more alkaline. Even in the plant as in the animal, this process is dependent upon the presence of oxygen so necessary to support life. Potatoes carry on respiration and the rate of this process may be greatly increased if an abnormal amount of carbon dioxide is present in the storage atmosphere. Some living processes that are inhibited by high temperatures, such as germination of lettuce seeds, may be promoted by carbon dioxide.

Roses may be prevented from opening if the half-open buds are held in the gas for a short period. The vitamin C content of some fruits and vegetables may be greatly reduced with exposure to carbon dioxide. These and many other items of fundamental knowledge have been gathered in an attempt to better understand the life processes in plant tissue.

Treatments of Tubers, Bulbs, Etc.

Special chemical treatments were developed for hastening the germination of recently-harvested potato tubers, shortening the sprouting time by one to two months, and extending the area in which an Autumn potato crop may be grown without the expense of cold storage of the seed-tubers

from the previous year. The same or similar chemical treatments may be used for forcing early blooming of gladiolus and of various ornamental plants such as lilac, flowering almond, crabapple, Astilbe, etc.

Also, the bulblets of gladiolus (many varieties of which germinate poorly or not at all in the year following harvest) may be forced to germinate by this chemical treatment, shortening the time for germination, increasing the yield (by increasing the number of bulblets that can be induced to germinate), and hastening the rate of propagation of newly introduced varieties. These treatments profoundly modify the metabolism of the plants increasing the respiration manyfold, altering the chemical composition of the tissue, and increasing the amount of certain substances (*e.g*. glutathione) ordinarily existing in these plants merely as traces. Thus, the work is carried on from two points of view : (a) to perfect the methods of chemical treatments so that the results may be of assistance to those who are growing plants either for pleasure or profit; (b) to study the physiological and chemical changes in the plant body as a result of the treatments, to the end that a better understanding may be had of the fundamental principles of plant life.

The work of the Boyce Thompson Institute on insecticides and fungicides, under the Herman Frasch Foundation for Research in Agricultural Chemistry deals with chemical methods of control, by means of sprays and dusts. Particular attention has been devoted to the development of accurate laboratory methods of testing fungicides and insecticides. For example, sulphur dust is widely used as a fungicide, but until recently its mode of action was unknown. Careful chemical studies have shown that fungous spores are able to change sulphur to toxic hydrogen sulphide gas which kills the spores. So we may say that the fungous spores "commit suicide."

Bordeaux mixture, another widely used fungicide contains copper in such an insoluble form that it has always been difficult to understand how it kills the fungous spores Investigations at this Institute have shown that fungous spores secrete compounds capable of dissolving the copper, which

then enters the spores and causes their death. One of the most valuable insecticides is pyrethrum, obtained from the flowers of a species of daisy, Chrysanthemum cinerariaefolium, widely grown in Japan and Yugoslavia. The active principles consist of two compounds which are esters, rather complicated in structure, which are found in the dried flowers. It is of great importance to be able to analyze samples of flowers and extracts chemically to find their content of these active principles. At this Institute studies have been made of several methods in use, and a new and more accurate method has been devised. The mode of action of pyrethrum on insects has also been obscure, but studies have shown that the active principles can penetrate through the integument of insect finally reaching the brain and nervous system where they act as nerve poisons

Considerable effort has been devoted to the search for new synthetic compounds having fungicidal or insecticidal properties. Among these the organic thiocyanates appear promising and many have been synthesized and tested.

ANALYSES OF PLANT CELL MEMBRANES.

One of the substances formed most abundantly by plants is cellulose. It is used by the plant itself in the formation of rigid membranes which surround the individual cells of the tissues. The crystalline cellulose of these membranes is intimately associated with colloidal materials which are also produced in the living plant cell.

At the Institute, crystalline cellulose has been identified in the protoplasm of the growing cell long before it is deposited in the membrane. It is in the form of uniformsized particles about six one hundred thousandths of an inch long. In the process of wall formation these cellulose particles are cemented together with the colloidal material in much the same manner that bricks and mortar are put together in a masonry wall. The plant thus obtains its characteristic properties of firmness and flexibility.

These discoveries are of fundamental importance in the understanding of plant structure and growth and also in the

industrial fields where cotton fibers, woodpulp, and other types of plant celluloses constitute the raw materials for manufacture.

The Chemical Foundat'on, Inc, has established this department to provide facilities for microscopic, chemical, and X-ray diffraction analyses of plant cell membranes from all parts of the plant kingdom.

AIR POLLUTION TO PLANTS, ANIMALS.

Scientists today are becoming increasingly concerned with the effects of Polluted city air on the health of man and the development of plant life.

Workers at the Instit te are studying the effects on both plants and animals of one of the most important atmospheric contaminants—sulphur dioxide, a poisonous gas formed by burning coal or fuel oil. An average of 2,000 tons of sulphur dioxide is discharged into the atmosphere of New York City each day, and research has shown that concentrations as low as 0·0001 per cent will injure sensitive plants in a short time. Strangely, however, very low concentrations such as are found in outlying suburban areas actually promote plant growth under certain conditions

In experiments of this nature precise control of concentrations is essential, so the Institute has developed somewhat elaborate apparatus for treating the plants and animals. Concentrations of the gas are measured automatically and are automatically recorded on special charts. Using this apparatus it has been possible to treat the experimental material continuously for periods as long as six weeks, with concentrations as low as 0 00001 per cent, and without varying in concentration more than 0·000002 per cent

DUTCH ELM DISEASE.

The New York State College of Agriculture, part of Cornell University, is conducting research on its own behalf at the Institute on the Dutch elm disease. This disease was introduced into this country at several ports by the import of elm·logs. Even though the logs were shipped to several points

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HOW TO EAT FRUIT AND WHY

By

K. F. A. Abel

The most valuable and health-giving way of eating fruit is to eat it raw. The real "life" of any fruit is in its fresh natural juices, and it is these that make fruit invaluable for health and general physical and mental well-being. Although it is good for one to eat fruit in any form, it is well to remember that cooking tends to rob fruit of its essential vitamins.

As a rule many people are not only ignorant but negligent of the many advantages which nature lavishly provides in the form of fruits. Fruit is essential for health, fascinating to the taste and convenient to use. Fruit is best taken when it is ripe, before or after meals. Cooked or stewed fruit with sugar is not half so valuable as fresh ripe fruit. Fruits are Nature's Gifts. Let us take the first fruits of the earth: the apple (King), the pear (Queen), the orange (Oriental Prince), and the lemon (the most useful of all serving maids.) The above four fruits can well be given first place in the fruit items of diet. It is said that for rapid and ready assimilation the orange and lemon come before the apple and the pear; but the latter have their own particular virtues. It ought to be a habit for everyone to partake daily of at least one fruit or a drink containing either fresh lemon or orange juice.

The most important matter to be considered is the favourable effects of fruit eating which begin at once though slight, but the most valuable effects are on the blood which is enriched and purified. Therefore it is necessay that fruit should be eaten not only regularly but always—even for a lifetime.

Most people are accustomed to treat fruit not as food but as a sweet-meat and eat just for pleasure or consider it a luxury. Fruit has medicinal value also. Miss Florence

Daniel in her book "Food Remedies" gives the following description about the medicinal uses of the four fruits mentioned in this article:

Apple.—"The apple contains a larger percentage of phosphorus than any other fruit or vegetable. For this reason it is an invaluable nerve and brain food. Apples are also invaluable to sufferers from the stone or calculus. Apples will afford much relief to sufferers from gout. Apples when eaten ripe and without the addition of sugar, diminish acidity in the stomach, other things being equal. An old remedy for weak or inflamed eyes is an apple poultice. A good remedy for a sore or relaxed throat is to take a raw apple and scrape it to a fine pulp with a silver teaspoon. Eat this pulp by the spoonful, very slowly, holding it against the back of the throat as long as possible before swallowing. Apple water or apple tea is an excellent drink for fever patients. Apples possess tonic properties and provoke appetite for food."

Pear.—"The pear possesses most of the virtues of the apple. But unlike the latter, it is credited with producing a constipating effect if eaten without its skin."

Orange.—"The orange possesses most of the virtues of the lemon, but in a modified form. But it has the advantage of being more palatable. The juice of oranges has been observed to exert such a beneficial influence on the blood as to prevent and cure influenza. The peel of the bitter orange is an excellent tonic and remedy in cases of malaria and ague. The "orange cure" is used with great success for consumptive patients, for chest affections of all kinds, for asthma and stomach complaints."

Lemon.—"Lemons are invaluable in cases of gout, malaria, rheumatism, and scurvy. They are also useful in fevers and liver complaints. Juice of one lemon taken in a little hot water is known to remove dizzy feelings in the head, accompanied by specks and lights dancing before the eyes. The juice of a lemon in hot water may be taken night and morning with advantage by sufferers from rheumatism. A Florentine doctor discovered that fresh lemon juice will alleviate the pain of cancerous ulceration of the tongue.

A German doctor found that fresh lemon juice kills the diptberia bacillus and advises a gargle of diluted lemon juice to diptheric patients. Such a gargle is excellent for sore throat. Dr. Fernie recommends lemon juice for nervous palpitation of the heart. Lemon juice rubbed on to corns will eventually do away with them, and if applied to unbroken chilblains will effect a cure. Lemon juice is also an old remedy for the removal of freckles and blackheads from the face. It should be rubbed in at bedtime, after washing with warm water."

All Brain-Workers Need Fruit,
Eat More Fruit And Have Less Worry;
Drink Less Liquids, Eat More Fruit,
It Pays In Health To Eat Fruit Daily.

(*Continued from page* 222)

throughout the country the disease has become serious only in an area of about 50 miles radius about New York.

The externally visible symptoms are wilting and yellowing of the leaves. If the bark is peeled from diseased branches, brown streaks are seen in the wood. The disease is caused by a beetle-borne fungus. This beetle lays its eggs in dead elm wood which may have been killed by the disease. As the adult emerges in the Spring it may carry some of the fungous spores on its body to the tree on which it is to feed. It feeds in the crotch formed by young growth and the spores may be easily introduced into the wound and spread throughout the tree.

At present the principal method of control used by agencies in charge of the practical control work consists in destroying diseased elm trees and also elm trees dead or dying from any cause, since these are breeding places for the beetle. Other methods of control are being tested such as spraying and testing for disease resistance.

Several publications are distributed by the Institute, the principal one being the quarterly "Contributions from Boyce Thompson Institute." It contains papers on developments in various phases of the work, each one of which is also reprinted for distribution separately.

THE BREEDING OF ANIMALS*

BY

E. ADLER, LECTURER IN ANIMAL HUSBANDRY,

College of Agriculture, Clen.

We are all aware of the fact that certain characteristics or qualities are hereditary. Sayings such as "Like father, like son", "The apple does not fall far from the tree", and "A chip of the old block" are in daily use.

The animal breeder is extremely interested in this matter of inheritance, and every farmer, knowingly or unknowingly, is applying some method of selection and breeding practice. No good farmer would wilfully grow crops from poor seed or mate inferior animals. I use the word "wilfully" because although many breeders may think they are doing the right thing, they may be wrong, merely because they have not a knowledge of genetics and not sufficient data on which to base their selection.

The study of genetics is an intricate one, and to understand the subject fully the breeder requires a thorough knowledge of the elementary principles governing animal and plant life, the make-up functions of living matter, reproduction, growth, etc.

A breeder who has no knowledge of the intricate science of genetics can make a success of the breeding of any class of live-stock, but it is nevertheless true that the basic facts of the science have exploded many of the erroneous beliefs of the past, and that its principles are being utilized more and more in the solution of problems which confront the breeder in his endeavour to obtain consistency in the production of high-class live-stock.

In this article, it is intended to give only an outline of the elementary principles of inheritance. Readers who are

* Borrowed from "Farming in South Africa," Vol XV, No. 169.

interested, are recommended to study one of the very numerous text-books on the subject. It should be stated that the Library of the Department of Agriculture and Forestry is at the service of the farming community. For the exceedingly small subscription of 3s. per annum and a deposit of 10s, a farmer can become a member and obtain literature on practically any subject appertaining to agriculture.

The animal body is composed of, or built up of, "cells". In the lower forms of life, an organism (animal or plant) may consist of but a single cell. Going up the scale through the different steps of evolution and cell differentiation, we arrive at the "higher" animals where there is an enormous number of cells combined in groups, the sum total of which constitutes the complex animal. The human body, the highest form of animal life, with its wonderfully intricate machinery for locomotion, respiration, digestion and its nervous system and brain, is nothing more than a combination of cells—cells differing in shape and function, but in a sense intrinsically all the same.

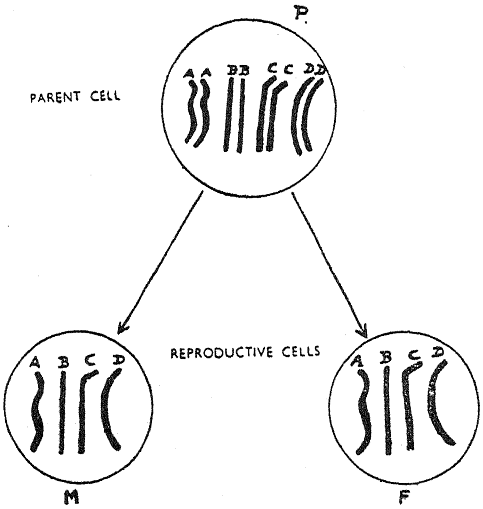
The Development of the Offspring

In the case of all the higher animals, including our farm animals, the offspring has two parents, and it is the result of the fusion of two cells—the male spermatozoon and the female ovum or egg-cell. These reproductive cells are produced by the tissues of specific organs in the body. The new being is born, not through any obscure process, but as the result of the combination of two reproductive cells. Any qualities inherited from the parent *must* be contained in these reproductive cells. Although the genetic make-up cannot change once conception has taken place, the growth and proper development of the new being is influenced by the health of the mother. Correct feeding and proper care of the mother before conception and during the period of gestation are essential to the well-being of the foetus. Once the animal is born, its future development depends on its environment and most important of all, its nutrition. No matter what good qualities the animal has inherited, their full expression depends upon food and good treatment. All the well-bred animal

inherits from its parents is the *potentiality* to grow into the desired size or shape or to produce the desired quality or quantity of product. After it has been born, its future is in the hands of the farmer. Better feeding must go hand in hand with improvement in breeding. A high-class animal will fail miserably if it is fed on "scrub" food; it is the lack of appreciation of this point that has caused many disappointments and failures.

Mendel's Researches

It was not until the discovery made by Gregor Mendel that light was thrown on the question: "How do the reproductive cells carry the factors of inheritance?" Mendel did wonderfull work by crossing sweet peas and recording his observations. His choice of the sweet pea was a lucky one because, since the plant used is self-pollinating, he had "pure" samples with which to work. After carrying out a certain number of experiments, Mendel was able to predict the results of certain crosses. Mendel's experiments are easy to follow and it is suggested that those interested should study one of the text-books on this subject. Mendel's Laws of Inheritance are the basis of the modern science of genetics. As a result of Mendel's work and subsequent experiments carried out by other workers on numerous plants and animals, such as fruit-flies, mice, rabbits and poultry, the study of genetics has advanced considerably. Since it is quite impossible in an article of this nature to go into details, the discussion will be confined to a few of the fundamentals of the mode of inheritance.



P=Parent Cell.
M and F=Reproductive Cells.
A, B, C and D=Chromosomes.
Figure 1

Chromosomes and Genes

The most important elements in the nucleus of the cells are certain rod-shaped particles called "chromosomes". These chromosomes exist in pairs, and the total number of chromosomes varies in different species The fruit-fly, for example, has 4 pairs, while the bovine has 38 pairs. The heritable qualities, called "factors" or 'genes" are carried in the chromosomes; they can be visualized as little dots or knots on the chromosomes. Each gene has a definite position on a particular chromosome, and each pair of chromosomes carries its definite heritable qualities For example, an animal may have 10 pairs of chromosomes yet only one pair carries the factors for eye-colour. These pairs of chromosomes are termed "homologous." As will be explained later, one chromosome of each homologous pair comes from one parent while the other comes from the other parent.

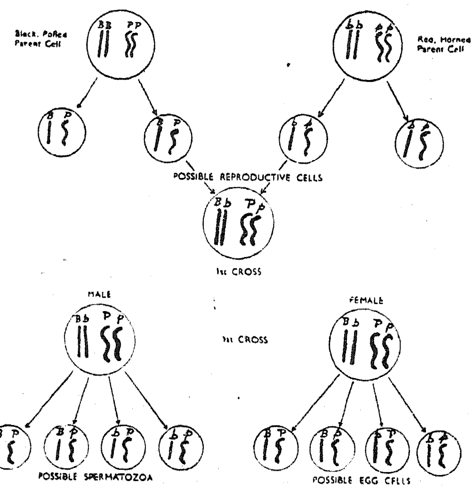


Figure 2

Body (somatic) cells are formed by a process of division. The chromosomes, with their genes, split length wise and one original cell gives rise to two daughter cells, each having exactly the same number of chromosomes and genes. What we term "growth" is nothing but a series of divisions of body cells. New cells come into existence in one way only—namely, by a process of division, which takes place in a pre-existing cell. A constant number of chromosomes is thus maintained in each cell, the actual number of chromosomes being peculiar to the species.

Reproductive Cells

The manner in which reproductive cells are formed in the specific tissues of the reproductive organs has been

carefully studied. Cytologists have succeeded in photographing (by microphotography) the stages of this process. The process of formation of body cells differs from that of reproductive cells. In the latter, the chromosomes first align in pairs and then separate, with the result that certain exchanges of genes can take place. One original cell, with say four pairs of chromosomes, gives rise to two reproductive cells, each having four single chromosomes. Because the homologous chromosomes have thus separated, there is a reductive division causing the reproductive cells to have just half the number of chromosomes that was present in the original cell. Actually, through further divisions, four sperm cells are formed from one primary germ cell. The development of the egg-cells of the females of animals is in all essential respects similar to the process by which the sperm cells of the males arise. The processes of the former differ in that of four cells produced, only one large egg-cell develops, the other being minute degenerate cells of no importance.

The formation of reproductive cells is illustrated in Figure 1 (all intermediate steps not shown).

The Genesis of the New Being

The new being is produced by the combination of two reproductive cells, which fuse and form a complete cell with its normal number of chromosomes restored.

Let us suppose that chromosome "A" is the one responsible for the colour of the animal's coat. It may be that the colour transmitted by "A" is white, but the existence of this colour may depend on a number of genes, the combination of these genes giving rise to the colour white. For example, one gene may carry the quality to produce red, but another gene in the same chromosome may inhibit the formation of red. A third may cause the colour white. The three genes combined may thus produce the colour white.

Certain factors or characteristics are dominant over others. For instance, the factors producing the black coat and the polled condition in the case of the Aberdeen Angus are dominant over the factors for the colour red and horns in the Afrikaner.

To make the matter less complicated let us forget for a moment about the existence of individual genes and think of the chromosomes as a whole as the carrier of the factors concerned The Aberdeen Angus has 38 chromosomes. Let us suppose that two chromosomes are responsible for the factors "black" and "polled" respectively, and let us call these chromosomes B and P. Similarly let us call the corresponding chromosomes of a red, horned animal b and p. The capital letters indicate the dominant characteristics and the smaller letters the recessive characteristics.

The chromosome pairs are thus BBPP and bbpp. If these two are mated the first cross will have the genetic make-up BbPp. Because B is dominant over b, and P over p, the first cross will be black and polled This first cross, although outwardly Black Polled will be genetically impure. If two of these first crosses are mated, the fact that they are not pure-bred (homozygous) will be evident. If sufficient matings are made to conform to the Law of Averages, there will be 16 possibilities genetically, although only 4 types exhibiting different external characteristics will emerge. The process is illustrated in Figure 2.

To obtain a second cross any one of the four spermatozoa can fertilize any one of the four egg-cells. There are thus 16 possibilities. They are: One Black Polled with the Chromosomes, BB PP; two Black Polled with the Chromosomes, Bb PP; two Black Polled with the Chromosomes, BB Pp; Four Black Polled with the Chromosome, Bb Pp: *total*, nine Black Polled; one black Horned with the Chromosomes, BB pp; two Black Horned with the Chromosomes, Bb pp: *total*, three Black and Horned; one Red Horned with the Chromosomes, bb pp: *total*, one Red and Horned; one Red Polled with the Chromosomes, bb PP; two Red Polled with the Chromosomes, bb Pp: *total*, three Red Polled.

This gives a total of 16 possibilities genetically, but there will apparently be only four types, namely 9 Black Polled, 3 Black Horned, 3 Red Polled, and 1 Red Horned.

This is just an illustration on the basis that only two factors are concerned. The matter is, however, far more intricate than this. The colour of mice, for example, depending

on four pairs of genes can be expressed in 256 different combinations. The bovine has 38 chromosomes and very many genes, and the possible combinations of these chromosomes and genes are so great that they extend beyond human conception. In practice, we try to intensify the good or desirable factors in one animal. The Bull BB PP. for example will breed true, but the bull Bb Pp, although outwardly like the former, is not genetically pure for the particular characteristics.

The breeder is interested in production, to which the whole body of the animal contributes. Production therefore is not dependent upon a few genes, but upon so many that it may appear that Mendel's Laws give very little practical assistance. Yet the knowledge we have at present is sufficient to serve as a foundation on which to base our methods of breeding. Very many strange beliefs have been proved false; the breeder of to-day knows what difficulties confront him and he is not groping in the dark, swayed by superstition or relying on "intuition" or "gifts." One belief which existed for many years was that the offspring inherited half of its parents' "blood," one-quarter of its grand-parent's, one-eighth of its great-grandparent's, one-sixteenth of its great-great-grandparents, and so on *ad infinitum.* What a sad outlook for the breeder if this were true; he would never be able to breed out any undesirable qualities or breed in good qualities. If there were no fusion of chromosomes and no re-shuffling and recombination of genes, all brothers and sisters would be absolutely alike; and if we carried this argument to its logical conclusion all individuals from common ancestors would be alike. Mendel's Laws explain very satisfactorily how a throw-back occurs; this "blood" theory does not.

Correct Selection and Mating

Because of the complexity of the genetic make-up variation is ever present. It is impossible for any two of our higher animals to be absolutely alike. There are differences in production. The breeder strives to raise the standard of his animals from the mediocre to the high. The average high producer of today, however, may be the average low

producer of to-morrow. The breeder makes use of variation, and improvement depends greatly upon "selection." It is the correct method of selection which has been the difficulty all along. For many years, selection was based on external appearance only. How dangerous this can be, will be evident if we recall the example given of the splitting of the chromosomes and the possible re-combinations obtained when a first-cross bull, the progeny of an Aberdeen Angus and a red horned animal, is considered. This first cross is black and polled and may possibly, owing to "hybrid vigour" be a better-looking bull than the original pure-bred Aberdeen Angus. If selection is based on appearance only, this cross-bred would most probably be selected and the results would be most disappointing.

Apart from conformation, type, and breed characteristics, selection must be based on something more accurate than the whim of the judge. In dairy cattle, milk yields and butter fat yields, and in beef cattle weight and quality of meat, are measurable factors. High producers can be identified only by the keeping of accurate records. We can often raise the standard from the mediocre to a higher average purely by means of breeding from higher-producing females and the sons of higher-producing females. This is the method which has been applied for some time. It has undoubtedly raised the average, but better methods are required for further progress; we must go a step further. It is not intended that some "super" animals should be bred simply for the sake of having a few outstandingly high producers. It may not be correct to aspire to very high production of relatively few individuals and find that the average production of the masses still falls far short of the quantity and quality desired for economic production. Our future breeding policies should be based upon the desirability of changing and improving the masses of our cattle through correct selection and mating. The testing of progeny is necessary if better stock are to be bred with greater certainty. This method should be used by all breeders. Breed Societies have done a great deal of good and it is hoped they will be the leaders in the field of progeny-testing, and that they will encourage, or even enforce, the keeping of better records by individual breeders in order to render pro-

geny-testing possible. It is encouraging to note that certain Dairy-Breed Societies have taken steps in this direction.

Practical breeders are aware of the fact that a bull which is used because of the high production of its parents and grandparents, sometimes proves disappointing when its progeny are tested. The proof of an animal's ability to transmit its desirable qualities is obtained when the offspring are tested and compared with the parents. However, a point of vital importance which is often overlooked when an animal is bought according to its pedigree is whether its parents and grandparents, etc., show consistency in transmitting the desired qualities. The mere fact that a cow can produce 6 gallons of milk daily does not necessarily prove that cow to be able to transmit this quality to her offspring. If one secures a record of the number of heifers by a certain bull, and if one studies their eventual production records together with those of their dams, one would obtain an excellent idea of the transmitting ability of the bull. For example, Bull "A" is mated to 60 cows. There are 30 daughters. The average production of the cows over 300 days is 3 gallons milk per day of $3\frac{1}{2}$ per cent. butterfat and the average production of the daughters (after working out mature equivalent) is 4 gallons of $3\frac{1}{2}$ per cent. milk; the bull's transmitting ability could then possibly be 5 gallons. If the daughters produce only 2 gallons (mature equivalent) then the bull's ability or index must have been about 1 gallon. In practice, such clear-cut dam; daughter comparisons are seldom available. Especially when one is working with stock of high quality, where it is a great achievement to raise the general standard just a little, the production of the daughters in comparison with that of the dams is often found to be variable Because we are dealing with animals which have such complex germ plasms, and because so many other factors, such as environment and management, influence production, the "indexing" of an animal is a most difficult matter. It is doubtful whether a farmer, not skilled in the science of genetics, would be able to compute bull indexes – a professional geneticist (possibly connected with a Breed Society) would be better equipped for the purpose.

Indexing of Bulls.

There are many different schemes and methods of computing a bull's index. Such schemes make allowances for age of daughters, times milked daily, etc.

The reader is referred to "Breeding Profitable Dairy Cattle" by Prentice (1935), "Animal Genetics" by Crew (1935) and "Breeding and Improvement of Farm Animals" by Rice (1935.) Of great interest is the pamphlet "Recent. Advances in Animal Genetics with Special Reference to Live Stock Breeding" by Prof. F. A. E H Crew. All these books and the pamphlet are obtainable from the Library of the Department of Agriculture and Forestry, Pretoria.

The books describe in detail different schemes for obtaining a bull's index. Whatever method is employed, an index or methodically compiled record should be of great value to the intelligent buyer who can read the indexes or records properly and who sees that he gets sufficient information on which to base his calculations. The difficulties are numerous: different methods of feeding, milking and treatment, and environment do cause variations in yield which will make comparisons inconsistent It is for the breeder to rectify or remove these obstacles as far as possible and for the buyer to keep a watch for any variations which may upset his calculations or comparisons. It may also be contended by some that to obtain proven sires or proven dams is a practical impossibility, because, by the time an animal has proved itself, it will be too old or possibly dead. Quite true, but, if only we knew which sires or dams were "proven," we would be able to compute a pedigree index of a young untried animal; such an index although not infallible, would eliminate to a far greater extent the uncertainty which exists to-day where young animals are bought solely on the score of the *producing ability* and not the *transmitting ability* of their forbears.

Readers should not get the mistaken idea that the indexing of bulls will be the panacea for all our breeding difficulties and that the breeder will no longer have to us his judgment and common sense. Resistance to disease, persis-

tency of lactation, mammary development, ease of milking, colour and quality of product, early maturity, longevity, etc., are factors which will also require to be considered. To produce animals not only capable of yielding large quantities of good-quality products, but of good type as well, should be the aim of every breeder. There are those extremists who state that it does not matter whether an animal is black or white, spotted or striped, or whether its legs are straight or crooked or its back hollow or hunched; such people hold that as long as the products of an animal are of the required quality, it should be used for breeding, for, they say, it is the profit in the pocket of the owner that matters, not type or conformation. The intention of this article is not to raise a controversy about type. As long as different people have different ideas of beauty, so long will there be preferences and prejudices as regards type The matter is not of great moment A quotation from "Breeding and Improvement of Farm Animals" by Rice is apt: "There is no proof that good type necessarily means good production, but there is also no indication that good type and high production of good quality products should not go hand in hand."

In-Breeding

If a buyer is satisfied with the type and the transmitting ability of a bull and finds that the bull has increased the production of his herd, should he risk in breeding? Mendel's Laws explain that by using a bull, his genes are linked with those of the females If we consider the enormous number of possible combinations of these genes with a heterogeneous or mixed lot of females (genetically), the danger of in-breeding does not seem so great. The possibilities are not only that the good factors will be doubled, but also that any bad factors will be equally accentuated. If a bull transmits certain good, but also some bad, characteristics, the chances are that as a result of in-breeding, both the good and the bad can be doubled in the offspring. There is a difference, however, between close-breeding (mating closely related animals, *e.g* full brothers and sisters, father and daughter) and line-breeding (mating more distant relations). There are many

advantages connected with a consistent system of breeding which tends to establish homozygosity for those characteristics taken into account in selection. There can be no hard and fast rule where in-breeding is concerned, for the material used will be the deciding factor Robert Blakewell, who was born in 1725, started with two Longhorn heifers and a bull, and bred for 20 years without introducing any outside blood. We all know what famous cattle were bred by Blakewell. Needless to say, the selection of the primary stock was of the greatest importance. Later workers have had varying results. E. G. Ritzman (New Hampshire Station) practised in-breeding with sheep for 15 years and although he selected the largest animal carefully and regularly, there was a definite decrease in size, yet no reduction in fertility.

If a bull produces good stock and brings about an all-round improvement it is possible that in a herd where the females are not directly related to him, moderate in-breeding will be beneficial; but where the bull is directly related to the females, in-breeding should be practised with caution and it should be left to the astute breeder who knows and understands thoroughly the stock with which he is working. In-breeding can be successfully practised only with animals which are known to be of high quality, fertility, and stamina. Animals which are heterozygous for these particular factors are not suited to in-breeding. It must be clear to all, that at present, owing to the paucity of reliable data, by far the great majority of animals cannot be used for this purpose. It all depends on the material used and the selection of the right material from time to time.

The Purchase of Bulls

In the past, bulls have been bought solely on the basis of their own conformation and the production (dairy breeds) and conformation (beef breeds) of their ancestors. This method has helped the beginner who buys a pedigree bull to grade up his relatively inferior stock, but once a fairly high average standard has been reached, this method becomes too much of a gamble. It is realized that the required informa-

tion is hard to get, but the buyer should make every endeavour to obtain all particulars he can and to buy either a proven animal or a young bull from proven stock. The conformation of the bull itself and of its ancestors should be taken into account. It should also be ascertained if possible, whether the bull's parents were able to *transmit* the desired qualities.

If purchasers will buy only from breeders who can supply the desired information, other breeders will soon see to it that proper records are kept and that the required information is produced. Those who advocate fuller and better recording systems and proven-sire schemes are often classed as unpractical, ranting idealists. The idealist of to-day, however, may be the realist of to-morrow.

In this article reference has been made mostly to cattle, but the same principles apply to all classes of live-stock

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"I would that the rural youth of to-day could see agriculture as the great preserver of culture, and the earth as the mother of mankind."

OLIVER EDWIN BAKER.

A deficient and uncertain water supply is one of the principal factors retarding the economic advance of India.

"The secret of success is to accomplish ordinary duties in an extraordinary Manner."—ROCKEFELLER.

"I owe all my success in life to having been always a quarter of an hour beforehand."—LORD NELSON.

"The peoples of India or China are restrained far more by ignorance of simple biological truths than by unfamiliarity with letters, Arithmetic, or the rules of trade."—OSCAR RIDDLE.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, U. P.

FOR MARCH, 1940

I—Season.—The rainfall in the 2nd week of March, 1940, was general throughout the province. In the remaining weeks it was light and scattered. Taken as a whole it was above the normal in most districts, Pilibhit, Ghazipur, Basti and Almora recording over 2 inches rain.

II—Agricultural Operations.—Agricultural operations are generally up to date. Harvesting of *rabi* crops and pressing of sugar-cane continue. Preparation of land for, and sowing and irrigation of extra crops and sugar-cane are in progress.

III—Standing Crops and IV—Prospects of the Harvest.—The condition of the standing crops is generally satisfactory and prospects are on the whole favourable except in the areas visited by hailstorms. The outturn of mango and mahua crops is estimated at about 12 annas in the rupee.

V—Damage to Crops.—Only Sitapur reports serious damage to *rabi* crops.

VI—Agricultural Stock.—The condition of agricultural stock is reported to be satisfactory. From the following figures furnished by the Director, Veterinary Services, United Provinces, Lucknow, it is indicated that except foot-and-mouth disease which has slightly increased, other cattle diseases are on the decline :

Diseases	February, 1940		March, 1940	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	2,387	1,199	1,166	648
Foot-and-mouth	2,984	21	3,639	49
Hæmorrhagic Septicaemia	264	220	84	80

VII—Pasturage and fodder.—Fodder and water are reported to be sufficient everywhere.

VIII—Trade and Prices.—Prices of the chief food grains have slightly fallen, while that of rice show slight increase. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

	End of February, 1940	End of March, 1940.
Wheat	4·086	4·077
Barley	3·183	2·939
Gram	3·823	3·548
Rice	4·644	4·670
Arhar dal	5·006	4·905

IX—Health and Labour in Rural Areas.—Agricultural and labouring classes are busy in harvesting operations and there is sufficient demand for labour. Small-pox is reported from a number of districts.

FOR APRIL, 1940

I.—Season.—The first two weeks of the month were practically rainless, but the rainfall in the third week was general. Light showers were received at places in the fourth week. The rainfall was above the normal in 20 districts.

II.—Agricultural Operations.—Agricultural operations are generally up-to-date. Threshing of *rabi*, sowing and irrigation of sugarcane and extra crops continue.

III.—Standing Crops and IV.—Prospects of the Harvest.—Standing crops are reported to be doing well and prospects are favourable.

V.—Damage to Crops.—No serious damage by hailstorm is reported.

VI.—Agricultural Stock.—The condition of agricultural stock is satisfatory. Rinderpest and foot-and-mouth diseases have both increased as will be seen from the following figures furnished by the Director of Veterinary Services, United Provinces, Lucknow:

	March, 1940		April, 1940	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	1,166	648	3,002	1,586
Foot-and-mouth	3,639	49	5,081	42
Hæmorrhagic septicaemia ..	84	80	42	40

VII.—Pasturage and Fodder.—Fodder and water are reported to be sufficient everywhere.

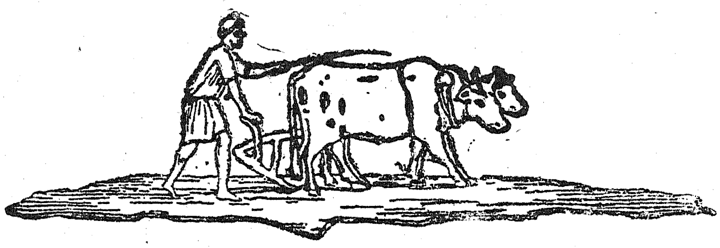
VIII—Trade and Prices.—Prices of the chief food grains except rice have further fallen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month:

	End of March, 1940	End of April, 1940
Wheat	4·077	3·725
Barley	2·939	2·680
Gram	3·548	3·268
Rice	4·670	4·865
Arhar dal	4·905	4·644

IX.—Health and Labour in Rural Areas.—The condition of agricultural and labouring classes is generally satisfactory. Cases of small-pox, cholera and out-break of fire are reported from certain districts.

THE

ALLAHABAD FARMER



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Editorials

Principles and Practices of Crop Production in India.

This is the title of a new book on the subject of crop production in this country. The book is in two parts: (I) General principles of crop production by C. P. Dutt and B. M. Pugh, and (II) Field Crops by B. M. Pugh and C. P. Dutt. Both parts however are in one volume. The book contains altogether 29 chapters, and is illustrated. The first ten chapters of Part I deal with the plants in general, the soil and its management, the improvement of crops, manures and fertilizers and weeds The other nineteen chapters of Part II deal with the crops most commonly grown in this country and more especially in the United Provinces. The important crops take one chapter each and are dealt with under the headings of origin and history, distribution in India, botanical description, ecological factors, classification, cultural methods, diseases and pests. The book contains 356 pages in all and is priced at Rs. 9. The book is available from B. M. Pugh, the editor of this journal.

The book we are sure will not only supply the long felt need of the students of agriculture in this country, but will also be read with interest by students abroad who are interested in Indian agriculture. Sir Maurice Hallett, the Governor of the United Provinces in his foreword says in part as follows: "This book should prove most helpful not only to students at the (Allahabad Agricultural) Institute, but to all agriculturists, to landholders and tenants; to the owners of large farms as well as to the cultivator of a small holding. It will no doubt soon get a wide circulation and I hope it may prove possible to translate portions of it, especially those portions which give practical advice to the cultivator, into the vernacular of the province, so that it may reach a wider circle of readers."

We therefore commend the book to the attention of our readers as we believe they will be greatly benefited by it.

The late Maharaja of Mysore

The Maharaja passed away on August 3rd, 1940, at 9 p.m. at his Palace at Bangalore. His Highness had been suffering from high blood-pressure, and succumbed to an heart attack.

"Colonel His Highness Maharaja Sir Sri Krishnaraja Wadiar Bahadur, G. C. S. I., G. B. E., was born on June 4, 1884. He succeeded to the *Gaddi* on February 1st, 1895. His Highness attained his majority in 1902 and on August 8th, of the same year he was invested with full ruling powers. His Highness celebrated the Silver Jubilee of his reign on August 8th, 1927.

"His Highness took a keen interest in the administration of the State. In constitutional developments Mysore took the lead under his guidance. The establishment of the University of Mysore, the institution of the Legislative Council, the inauguration of the Iron Works at Bhadravati and the construction of the Krishnarajasagara Dam and Reservoir and of the Irwin Canal are a few of the outstanding features of the reign of His Highness.

"His Highness was a keen sportsman, a fine polo, tennis and racquet player, and an excellent shot."

His Highness left no stone unturned to effect an all-round improvement of the people of his State. He was deeply interested in their moral, educational, and economic welfare.

By the death of His Highness not only the people of Mysore but the whole of India is deprived of a great ruler and friend.

The Allahabad Agricultural Institute conveys to Her Highness the Maharani, the Yuvaraja, the Yuvarani, the Dewan, State Officials and the people of Mysore, sincere condolence.

Dr. and Mrs. Higginbottom's return to India.

Most of the readers of "The Allahabad Farmer" who know Dr. Higginbottom, the Principal of the Allahabad Agricultural Institute, will be glad to learn of his safe return and that of Mrs. Higginbottom to this country. They left here in March, 1938, expecting to return after a year. But at the end of their regular furlough Dr. Higginbottom was elected Moderator of the Presbyterian Church in the United States of America, the highest position which that body could confer upon any of its members. After serving the Church in that capacity for one year he now returns to India, the field of his labours, where we hope he will spend many more years of fruitful service.

"Don't expect to enjoy the cream of life if you keep the milk of human kindness all bottled up."

"Let the farmer forevermore be honoured in his calling; for they who labour in the earth are the chosen people of God,"—

THOMAS JEFFERSON.

THE MANUFACTURE OF AGRICULTURAL IMPLEMENTS AND DAIRY EQUIPMENT IN INDIA

BY

M. VAUGH.

Agricultural Engineer, Allahabad Agricultural Institute.

Until a few decades ago India was self sufficing in agricultural implements, using only the simplest sorts of things and making them in innumerable villages where they were used. This system ensured a ready supply and eliminated transportation costs and dealer's profits, but restricted the purchaser to the ability of the local mechanic, aud the mechanic to what he could produce with hand tools and locally available material, mainly wood. Within these restrictions, the Indian farmer and the mechanic showed considerable ingenuity, but the restrictions prevented the production of anything but very simple tools and implements.

The coming of the industrial revolution made available power in amounts before undreamed of and this in turn made available new materials, particularly iron and steel, but others also, especially suited to the making of implements. The agricultural revolution, logically following the other, led to the development of a wide variety of new implements and machines in the West and it was natural that as intercourse with the West developed, these should come to India for trial. Some were found more or less suitable and have been imported in considerable numbers. Some have been modified and adapted and have been manufactured wholly or in part in India in fairly large numbers. Examples of the latter are small sugar cane mills, small chaff cutters and small ploughs of simple types. One firm in South India has extensively developed the manufacture of heavier pattern ploughs, particularly the cast iron ploughs.

The earliest form of iron to be used by man was probably some form of wrought iron or low grade steel. This could be made and was made till very recent times in India by very simple methods and with very simple equipment without actually melting the iron. Only in specially favoured places where, cooking coal and natural draft were available together was it possible to melt any considerable quantity of iron and so get cast iron. The process was known however, and as soon as power became available for blowing the fires, there was a great development of the use of cast iron. It was only later when the invention of the Bessemer converter and large sized open hearth furnaces made steel in various qualities available at lower cost that steel began to come in to extensive use. Cast iron had the advantage of requiring only relatively simple equipment for its fabrication and of taking the form of the mold into which it was poured, making possible the fabrication of intricate shapes very difficult to make from steel. Relatively small workshops with very small investment of capital could manufacture parts of cast iron, so in the early days cast iron was used for every possible purpose, both in industrial machines and in agricultural implements. Many small workshops sprang up in India making castings and some of them still continue to make machine parts for repairs, ornamental fencing and other parts.

Steel in its various qualities is outstandingly the best material for all sorts of agricultural implements today. It has great strength in every way, is not easily broken and, if of the correct quality and properly used, gives excellent wear. Being forgeable, cutting edges can be sharpened by heating and hammering and the degree of hardness desired can be secured by first selecting a suitable quality of metal and then by heating and cooling properly. By the use of suitable forging machines, it can be given almost any shape desired and by the electric welding of two or more parts together after shaping them, it is possible to get almost any conceivable shape practically as cheaply as cast iron parts. Cast irom has the disadvantage of being easily broken if twisted, bent or struck a blow. It is excellent for such parts as the rollers of sugar cane mills where the whole force is

compressive, though even here it is fitted with a steel shaft. It can be made very hard for such things as plough shares, but once shaped can be sharpened only by grinding with special grinding wheels not ordinarily avilable in villages. Steel has practically completely replaced cast iron in modern implements in America, except for a few parts which require special furnaces and processes not avilable to the small workshop for their manufacture.

Up till now, the manufacture of implements in India has been largely confined to the making of those things which could be made from cast iron Ploughs have been made in considerable numbers, using cast iron bodies and in some cases imported cast iron shares. Wooden beams have been generally used or simple steel beams have been bolted to cast iron bodies Most of the implements have been frank copies of imported models which they resembled in every detail except number or name. Probably the only plough until recently designed in India for Indian conditions was the "Meston" widely copied under other names, designed originally by an English firm. Doubtless there were other designs but none to attain any wide popularity. Besides ploughs, cane crushing mills and small chaff cutters, for the most part exact copies of imported implements, have been made in fairly large numbers at several centers, using mostly cast iron parts of local manufacture and imported steel parts, such as knives were necessary. Recently there has been some development of the local manufacture of steel chaff cutter, knives in India, though this is very much hampered by the lack of a suitable supply of steel sheets.

After some 20 years of experience testing various types of implements, about 10 years ago the Agricultural Institute began the manufacture of small ploughs to its own designs, embodying new features not previously used in India and using steel of various grades for all parts. Because of the unsatisfactory service cast iron ploughs had given on the Institute farm, no cast parts were used in any of the ploughs. Manufacture was hampered at first by the lack of any machine tools for forging or shaping or even for shearing and

punching holes. However, by purely hand methods and with the simplest equipment, except for an electric welder, considerable numbers of ploughs were made and sold widely. However, it was recognised that real success could not be attained until better facilities were available.

During the last financial year, the United Provinces Government gave the Institute a small grant to enable it to install a power shear and punch, a power hammer, a drop forging hammer and furnaces, etc., in addition to a certain other equipment which the Institute has secured from other sources The installation of this new equipment has been delayed very much by the war, but is now nearing completion It will greatly increase the capacity of the Institute workshops and will make possible improvements in finish of implements. In return for this grant, the Institute has agreed to make such implements as may be required of it by the Director of Agriculture. At present the machinery being installed is entirely for the working of steel, no provision being made for casting. A few small parts to be made of cast iron will be purchased from existing foundries.

Along with this improvement in equipment, the Institute is increasing the variety of implements being made. In addition to the three types of ploughs already being widely sold, a grain drill has been developed and will be available for this "rabi" season. It will sow all the common field grain crops with the possible exception of maize, is built entirely of iron, mostly of steel, except for the hitch. It can be used for sowing closely spaced crops such as wheat, barley and gram, or for sowing in more widely spaced lines for interculture of juar, bajra, etc. Other implements are being developed and will be announced in the pages of the "FARMER" as ready.

From its start, the Institute has been interested in the development of the dairy industry. Over a period of several years it has experimented with the manufacture of small churns and butter workers and is now putting on the market a line of small dairy equipment suited to local needs. Churns and butter workers are now available of improved designs, made by Indian labour from Indian materials and at prices well below pre war prices for such equipment. A small

experimental pasteuriser has also been built and *ghi* boiling equipment is under development. It is planned to be able within this year to meet most of the demands of India for small scale dairy equipment except for separators. No plans have been made so far for the manufacture of separator or similar machinery.

The development of this plant is believed to mark a new stage in the manufacture of agricultural implements in India. It makes available to the farmer materials long used by the building contractor and others, made in India of Indian materials and much better suited to his needs. It also marks a definite break with the dependence on foreign designs; it is not intended that any implement not designed in India will be made. It will be used for the development of manufacturing techniques which can be applied in other small implement factories which will be needed all over India. It will be an additional facility for the use of students of agricultural engineering at the Institute.

At the beginning of this article it was said that until recently, India was self-sufficient in agricultural implements. The agricultural revolution in western countries has for the time being made India somewhat dependent on other countries for certain lines of agricultural machinery which she needs, but must forego the advantages of or import them. The only hope of improving the standard of living in India is through the increase of production per worker. We hear much of the need of industrialising India, in which I firmly believe. However, any large industrialisation will require a supply of industrial labour not now available and which can only be secured by releasing agricultural labour. The use of relatively simple bullock powered implements will enable us not only to release some labour now only partly occupied in agriculture for full time industrial employment, but will also enable us to release women and children from field work. Better homes are impossible for large numbers in India so long as the wife and mother must spend long hours in the fields. We will always have an adult literacy problem unless along with our campaign for adult literacy, we release the

(*Continued on page* 253.)

SPICE-PRODUCING PLANTS

By

S. Chowdhury

It is somewhat difficult to separate spices from the aromatic flavouring agents, such as anise seed and bay leaves. As a rule, however, spices have a sharp, pungent taste modified by other flavours characteristic of each sort. Most of them are used in a ground state, owing to the necessity of using them in small quantities, because of the intensity of the taste-sensations which they impart. Many aromatic products are much milder and can be used in a whole state without the development of too powerful sensations. These more powerful flavouring agents, by common usage known as spices, are here briefly discussed.

Botanical Sources :—The common spices are derived from almost as many botanical families as there are spices, and nearly all products here concerned are of tropical origin. The Banana family (*Scitaminaceae*) includes a series of perennial, herbaceous rather succulent plants, having strong flavouring properties distributed more or less widely throughout the plant, as ginger, turmeric and cardamoms. The Nutmeg family (*Myristicaceae*) furnishes nutmegs and mace, products derived from the fruit of the nutmeg tree. The Myrtle family (*Myrtaceae*) supplies two of our most important spices, cloves and allspice. The Laurel family (*Lauraceae*) yields cinnamon bark and cassia buds, products of a number of spices of the genus *Cinnamomum*. Black and white pepper are derived from the same plant, *Piper nigrum*, a member of the Pepper family (*Piperaceae*). Red pepper is not a member of the Pepper family, belonging rather to the potato family *Solanaceae*. *Dhania*, *Jira*, *Saunf* or *Mauri* are derived from the plants *Coriandrum sativum*, *Cuminum cyminum* and *Foeniculum vulgare* respectively, all members of the family *Umbelliferae*. Mustard is furnished by members of the Mustard family (*Cruciferae*).

Parts used and Method of Preparation:—The parts of the plants used in making spices seem to be determined by three points :

(*i*) The part must contain the pungent or aromatic principle in large quantity.

(*ii*) It must be accompanied by other tastes giving a pleasant combination, or it must at least lack unpleasant constituents.

(*iii*) The texture of the product must not be too hard, tough or woody for proper grinding and use. Consequently, in general, spices consist of the tender parts of the plants, such as the inner bark, seeds capable of ready grinding, buds, rhizomes and fruits.

Among the spices above mentioned, ginger and its near relative, turmeric, are made from the younger, tender parts of the rhizome. Cinnamon consists of the carefully cleaned and dried inner bark of the smaller branches of the tree. Cloves consists of the unopened flower-buds picked and carefully dried. Cassia buds represent immature fruits enclosed in the clayx of the flower. Allspice consists of the full sized but immature fruit picked from the pimento tree while still rich in the pungent principles. These in part disappear on ripening.

Black pepper consists of the small round fruits of the pepper vine, plucked when the colour has changed from green to red. These hardly ripe berries are more pungent than when fully ripe. White pepper is prepared from this fruit after it has ripened. The berries are soaked in water and the dark pulpy covering bruised off. The remaining part is less aromatic and pungent than the black pepper. Red pepper are the ripe dried fruits of *Capsicum* sp.

Mustard consists of the mature seeds. Nutmegs are the hard inner kernel of the fruit of the nutmeg tree. The entire fruit, having the size of a small apple, consists of three parts; an outer fleshy pulpy covering, beneath which is found the mace, occurring as a partial covering over the kernel or nutmeg proper. All parts are aromatic, but the mace and kernel are specially so.

Dhania, Jira and Saunf are the mature ripe dried fruits of the *Coriandrum sativum*, *Cuminum cyminum* and *Foeniculum vulgare* plants respectively.

Geographical Sources:—Red peppers and mustard are grown quite extensively in India. Black and white pepper together form an important interest in India, Malaya Peninsula, Ceylon and other parts of the tropical eastern Asia. Cloves form a very valuable resource in Zanzibar, also in the Molucca islands and are widely cultivated in other parts of the tropics including India. Cinnamon products are secured chiefly from Ceylon and Indo-China and other regions in tropical Eastern Asia. Allspice is derived chiefly from the Antilles, Central America and Jamaica. Ginger is widely cultivated the world over in tropical and sub-tropical regions, Jamaica, India and parts of Africa Turmeric has a similar range, but is secured in commerce chiefly from India. *Dhania*, *Jira*, and *Saunf* are grown chiefly in India. Nutmegs and mace are grown in certain Islands of the Indian archipelago, but the chief commercial sources continue to lie in tropical eastern Asia

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The Manufacture of Agricultural Implements and Dairy Equipments in India

(*Continued from page* 250.)

children from long hours of field work and allow them time for schooling so they can become literate before they become adults. Raising the standard of living in India will have to start with an improved implement industry making improved implements in India suited to Indian conditions. The full utilisation of most of the benefits from other lines of agricultural improvement will depend on the necessary implements being available.

It is the object of the Institute to help make India again self sufficient in agricultural implements, but with improved implements suited to modern conditions and enabling India to compete in agricultural production with the West and on the basis of a standard of living in India not inferior to that of other countries.

COTTON BREEDING PROBLEMS IN THE UNITED PROVINCES

By

M. P. Singh, M.Sc.

Formerly Cotton Research Officer, Rangamati.

The lack of adequate demand for short staple cottons commonly grown in U.P., and the consequent decline of the area under cotton in the Province, has created a position which calls forth serious consideration from all those who are interested in this industry. The situation, examined from the point of view of the cotton breeder, offers several lines of approach.

The necessity of evolving economical long staple varieties.—It is clear that long staple varieties are to be evolved in view of their greater demand as they have a better spinning performance In doing so provision has to be made against the severe competition likely to result for the improved types both within this country and outside.

The competition is likely to be both severe and prolonged. The following are a few of the potent facts, giving some idea of the keenness of the competition that is likely to result. Russia, China, Brazil, Peru, Argentina, and Australia are focussing their attention in extending their areas under quality cottons. In Africa large areas are being rapidly opened up for cotton production. A five year programme planned by Japan in Manchuria, with a view to make herself independent of her lint requirements, is already being worked out. The U. S. A. cannot for long continue the present self-imposed restriction for cotton production. Within this country too, the main quality cotton tracts are the Karunganni and the area north of it in the Madras Presidency, the canal colonies of the Punjab and Sindh, the Dharwar and Surat areas in the Bombay

Presidency, and the Black Cotton soil tract in Malwa, Central India and the Central Provinces.

In this world-wide race for production of the quality cottons, only those countries that can raise cotton at the lowest cost can stand out to the end. If U.P. wants to take a bold front, improvement in quality alone will not be sufficient. It should also be able to produce cotton at a low cost. In order to achieve this end, reduction in picking charges, minimising the cost of irrigation in the case of the irrigated cottons, and introduction of improvements in the weeding and cultural operations of the cotton fields, are the main directions in which development can be sought. It is needless to stress that in addition to the above factors, enhancement of yield per acre is of paramount importance. The chief and the constant efforts therefore, should more than ever be to effect improvement in quality along with the higher yield per acre. To attain this end it is imperative that selections from the very beginning should be on the basis of the final yield. The improvement in the final yield per acre could be brought about by breeding for earliness, disease and drought resistance, and inherent high productivity, or through some other new factors.

The stress on this commonplace subject is necessary due to the existence of a school of thought, which holds that improvement in quality alone should be the first and the foremost concern, as, in its opinion, it will in the long run, prove to be the most profitable to the grower. That this is not the case in actual practice is amply substantiated by certain experiences. The lesson learnt in Madras that the premium obtained for quality is not sufficiently encouraging for the development of the area under improved types, and the report of Mr. Jackson from Malwa that only a premium of 15% is obtainable for cottons with large improvement in quality are some of the citations against this argument. Such conditions are not only peculiar to India, but also to U.S.A., where the cultivator is progressive, and much more enlightened, and where highly organised marketing activities exist. To quote an example nothing more need be said than to point to Ashton's (1935) conclusion,

that the study of the markets of Texas, Louisiana, and Arkansas, reveals that the premia obtainable for quality are not adequate to encourage the extension of the areas under improved types.

What Varieties to Concentrate upon—Asiatic or American?—The cottons commonly grown in U.P. belong to *G. arboreum* var. *neglecta*, forma *bengalensis*, which are high ginning with coarse and short staple, not fit for higher spinning. On account of the poor staple properties, the U.P. cottons do not deserve more serious consideration than what is needed for selection of parents for crossing due to their high ginning property and fair resistance to disease.

The introduction of a suitable variety therefore seems to be inevitable. The numerous breeding experiments on the Asiatic cottons conducted at several research stations in India, with the exception of those done in Central Provinces, Berar, and Surat, seem to indicate a general tendency for improvement in lint length to be associated with a reduction in yield and ginning percentage. But the absence of the negative correlation in F_2 between lint length and ginning percentage among the Asiatics leaves a possibility of the combination of the above characters in a type for an optimist. (Hutchinson in the conference of scientific research workers on cotton in India). Still the experiments referred to are suggestive of the poor limits inherent in the Asiatic group of cottons, with regard to the combination of ginning percentage and length. Moreover Todd (1934) has shown that 89·5% of the Asiatic group is below 7/8″ while only 9·7% is under this length in the Americans. The number of fibers per seed in the standard cotton of the Asiatic group varies from 2,500—10,600, while in the Americans the range is from 7,000—14,900, and that the former types do not show much improvement in fineness with increase in fibre length, while in the latter, fiber of longer length have less fiber weight per inch. (Iyyangar and Turner 1930). Besides, the fact that Americans are allopolyploides with twice the number of chromosomes of the Asiatics is suggestive of the possibility of the occurrence of duplicate genes for lint length and yield, as well as better physiological adaptation than the Asiatic diploid.

Is American material likely to be profitable ? – The above facts point clearly in favour of the Americans in the place of short staple cottons of U. P. The existence of varieties with high lint length and yield in Egypt and California lends further support to the view, that the Americans are better adapted to superior lint production than the Asiatics. The larger boll size in the Americans lowers the picking charges as compared to the Asiatics, a factor of considerable importance for the grower. Taken collectively the above points support the idea that in schemes of breeding for quality, American material is likely to prove better than the Asiatics. This is further substantiated when the world's tendency to favour the American cottons in new areas is considered. In Sudan, when the American cottons began to grow on a large scale, the cultivation of native cottons was prohibited. (Huddleton). Russia and China are changing over to American types. The extension of cotton cultivation in Brazil, Argentina, and Manchuria is of the American group.

But on the contrary when considerations regarding certain disabilities experienced in growing the American types in various places are taken, the situation does not appear to be so encouraging. It is a common experience that American types are less hardy, late maturing, more susceptible to water-logged conditions, more prone to cotton failures, liable to red leaf blight and more inclined to be neppy . Besides they need early sowings, larger number of irrigations, and greater care in general cultivation. An additional argument against their adoption is furnished by the failure of the attempts made by the East India Company in 1788, and of the provincial departments later on, except in the case of Dharwar and Punjab Americans. The attempt of the East India Company may be regarded as conclusive, because at the time when the attempt was made no systematic plant breeding work was taken up by the U. S. A., and the material tried in India must have been sufficiently variable, and fit to indicate roughly where the American cottons could succeed. It has been pointed out by Hutchinson, that when American varieties only were cultivated in Argentina, successful improvement resulted from selection of the annual forms of local

Barbadense, rather than from the introduction of Hirsutums from North America

It will thus be observed that difficulties are sometimes encountered in acclimatising American cottons even in America. New types lack considerably in their acclimatising capacity, having lost a major portion of their variability on account of present purification through the application of modern methods of plant breeding. Variability which must have been present considerably in the last century to enable the American cottons to adapt themselves to new conditions, must be at its minimum now. Besides, more fruitful results would have been achieved from the attempts of the introductions of the Cambodias in the South, and the Egyptians in Sind. And, in their absence, the possibility that the limits of the successful introduction of the Americans has been reached in India is suggestive. The recommendations of the Mackenna's Indian Cotton Committee of 1919 on the question of expansion of American cottons were also very guarded. In addition to the above facts, when the experiences of the countries going in straight for the exotics is considered, very encouraging results are not come across; and the future programmes in such cases foreshadow the reversal of the policy. The exploitation of the finer components of the indigenous cotton of Russia, and of the neighbouring tracts by the Russians instead of exclusively concentrating on the acclimatisation of the exotic species, (Bordakov and Ivanova 1935, Konstaniner 1936) and the difficulty of introducing the American cottons in the rotations of China on account of their long growing season, is sufficient to cast a doubt on the utility of the introduction of the American material.

New phases of the introduction of the American material—In the light of the increased knowledge of the breeding technique, it may be possible to study new phases in the introduction of American forms which have not been so far thoroughly investigated. The method of inter-specific crossing for increasing the variability with a view to isolate the segregates which are either better adapted to the sorroundings, or have a combination of better lint qualities

have also not met with any great success. The crosses between the upland and the Egyptians about which Russians are most optimistic offer no possibility to Harland. He is of the opinion that the seggregates in such cases are not better than either of the parents. Continued back crossing offers promise only to the extent of transferring some qualities of one parent on to the other.

In addition to the former aspect of evolving American forms by continued back crossing, a second possibility, in view of the less hardy nature of the American forms, is to transfer the hardiness of the indigenous forms to Americans. In this connection the feasibility of the arboreum × hirsutum crosses effected by Harland (1932), which are quite early, and the possibility of the Asiatic American crosses obtained at Broach and Surat, may be exploited to the full by further crossing and back crossing.

These facts place the problem of introduction and improvement of the American cottons on a new footing. But it must be clearly understood that the new aspect of the introduction of American forms is essentially a trial and error method, and as such is much time consuming.

The indigenous cottons.—The Royal Commission of Agriculture in India emphasised the point that work on the improvement of the indigenous types should take precedence of the exotics. Concentrating our attention to the indigenous material it appears to have been indicated that the Indian cotton in their spinning performance give more consistent results as compared to the American forms. In the early years of their introduction the Americans give encouraging results which later on dwindle away gradually (N. Ahmad, 1937 in the Conference of the Cotton Research Workers in India). This consideration seems to point out that most careful attention should be given to the study of the indigenous cottons as they are more reliable.

The tendency of the longer lint to be associated with low yield, and poor ginning percentage in the indigenous cottons is really unfortunate. But in view of the time and energy spent on the study of the American material it can be

seen that the results achieved have hardly justified the trouble involved, while, on the other hand, the results obtained through the investigation of the indigenous cottons are comparatively brighter, considering the time and the energy spent. Hutchinson has opined at Indore, that the potential yielding capacity was at least as great in the northern *neglectum* (roseums) under black soil condition, as it was in the best acclimatised American cottons; while the *neglectum* realised a greater proportion of their potential yield under ordinary conditions than American cotton could do He did not, however, consider it to be true in all cases, the case of Cambodia in South India being an exception Still he thought, "that there was a very wide range of conditions in India for which Indian cottons were far more suited for yield and quality than Americans." Differences in the climatic conditions of the Eastern part of U. P., and the existence of a particular type of cotton *G. intermedium* (Todaro) there, is a specific case to support the view that regional types could be evolved.

The inferior cotton in India is mostly from the roseum stock of which United Provinces is one of the main tracts. It has been concluded by Hutchinson and Ghose, 1937/1, that the influx of roseum in the North of India is of comparatively recent origin, dating from about a century back, mainly due to the advent of modern gins paying decent premiums for high ginning percentage. This preference for high ginning quality chiefly due to higher lint weight per inch, on account of the greater thickness of the fibres, and not to increased length or larger number of hairs per unit area of seed coat, resulted into cultivation of types with coarse hairs Forms with greater lint length associated with fineness got consequently eliminated as they could not gin as high as the coarse types. The range of ginning percentage in roseums is from 30–40 %. That these types are obviously the invaders, is supported (1) by the argument that in 1840, ginning percentage higher than 28 was very rare in India (Returns 1847) and (2) by the contents of one of the East India Company's letter of 1780 that "a lot of fairly long staple cotton was being cultivated in portions of U. P. called the Vazier's dominions." Prince in Return 1847 states that "in

1844 when the Dacca Muslim industry was rapidly declining both the triennial and the coarse annual cottons were being grown in the Dacca district," and it has been safely concluded by Hutchinson that the invasion of the Gangetic plain by coarse annual forms of *G. arboreum* var. *neglecta* forma *bengalensis*, commenced when the machine-made cotton goods from England began to compete successfully with the fine hand-made local Muslin. Forms of variety *neglecta* forma *bengalensis* appear to have originated from Bengal and Assam from the same stock which gave rise to high ginning cernuums that are well suited to hill cultivation under condition of heavy rainfall. The high ginning percentage of U. P. cottons is therefore a desirable quality.

Recent work on Southern arboreums (indicums), distributed in Peninsular India, South of the Tapti river, Kathiawar, Gujarat, and Ceylon has revealed a range of ginning percentage from 25 to 30, associated with long and smooth staple, and the possibility of the combination of these qualities with roseums is encouraging. To cite an example, the progenies of a cross of C. 520 (roseum) and Bani (indicum) holding out a considerable promise as medium staple and high ginning types, is sufficient to convince one regarding the usefulness of such an attempt. Hutchinson and Govande (1938) have discovered the fact that Upland cottons inspite of their reputation as quality cottons are inferior to herbaceum and indicum in spinning quality. This fact could be further established with regard to the other finer groups of the indigenous cottons had the study of their relationship and distribution been available. For the attention given to the acclimatisation of the Upland cottons in India this discovery may be disappointing, and thus the value of the direct introduction of an exotic remains problematical. This finding therefore emphasises the question in favour of the indigenous cottons and that also for either herbaceum or indicums. Since the indicums are also associated with a fairly good ginning percentage they very much seem to offer a solution for the cotton problem of the province.

The Solution.—The solution of the problem through indicums lies in either of the following two lines of approach,

(*a*) The search for plants of indicum types in areas recently invaded by roseum– since the latter are invaders,— may be useful. This line of work has yielded valuable results in the Central Provinces, Central India and Khandesh. The recent discovery of similar indicum forms in Rajputana by Hutchinson and Ghose, 1937/1, has made possible the extension of this line of work in the Bengal tract covering Assam, Bengal, Gangetic Plain, Punjab and Central India. But the study of the exhaustive collections of the Bundelkhand and Rohilkhand tracts made at Indore by the author, had led to the conclusion that there are very little chances of improvement by selection in the true Bengal tract, such as the United Provinces.

(*b*) Hybridization between the indicum types and the promising forms of the above collection when made, appears to be the alternative line of approach. The study of the crosses between roseums and indicums has yielded valuable results as aforesaid.

Incidentally, it is of interest to note that somewhat inadequate collection of the material from Burma revealed a great amount of variability in quality. Forms with ginning percentage as high as 40, with reasonably fine lint, and possessing a staple length of one inch, have been met with. (Hutchinson). The study of the variability of these forms from Burma will be interesting and may also prove to be one of the useful materials for improvement in cottons for quality in the United Provinces. It is of interest to note that cotton forms from Burma have the same ancestry as the roseums of U. P., and the indicums of Central and Southern India.

To sum up, the solution of the present cotton situation reflected in a decline of the area under cotton in U. P , due to a number of economic, climatic, and other causes lies in the synthesis of the economic characters distributed in the *G. arboreum* group in all the three forms *viz*, *bengalensis*, (roseum) indica (indicums) and burmanica (Burma Forms), along with the improvement in the agricultural and marketing practices. The present cotton situation in U. P., therefore, demands a well considered plan attacking the problem in all

possible directions in the light of the recent advances made in cotton breeding in India and in other countries.

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Look within. Within is the fountain of good, and it will ever bubble up, if thou will ever dig.—

MARCUS AURELEINS.

When we are out of sorts things get on our nerves, the most trifling annoyances assume the proportions of a catastrophe. It is a sure sign that we need rest.—

LORD AVERBURY.

FRUIT PLANTS AND THE HONEY BEE

By

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Director, Jeolikote Apiary.

It is now well established that colour, scent and conspicuousness in flowers have been developed as aids to the flower in its struggle to produce seed through cross-pollination. This knowledge has been comparatively recently acquired by man, (less than 200 years ago), and, therefore, we find that the intimate relationship which exists between plants and insects, specially the honey bee, has not yet been fully exploited for the benefit of agriculture and horticulture.

With the possible exception of the silkworm, our knowledge of no other insect is so ancient as our knowledge of the honey bee. At a time when the sugar cane was unknown the honey bee was much sought after as the only source of sweet known to man. We know that large apiaries existed in ancient Egypt more than 3000 years ago. But from these ancient times till now the honey bee has continued to be regarded, both in the mind of the scientist and the man-in-the-street, as of value to man merely on account of its honey-gathering qualities.

It is only very recently that the great services which the honey bee renders in the sphere of cross-pollination have been recognised, but unfortunately this knowledge is still confined to the scientist and the specialist. Today these scientists are asserting that the real value of the honey bee to man lies in the services it performs for agriculture and horticulture, and that its value as a producer of honey is only of secondary importance.

Originally, we are told, all flowers were green like the rest of the plant and consequently quite inconspicuous like those of the grasses and most other anemophilous plants. These plants depend mainly on wind for the performance

of those services which are performed by the honey bee and other insects in the case of entomophilous plants. Wind as an agent is wasteful and uncertain. Insects effect cross-pollination much more efficiently. Entomophilous flowers have acquired characteristics which attract the bees and other anthophilous insects. The bees know that by visiting these flowers they will obtain nectar and pollen which they need for their food. Thus a relationship of mutual inter-dependence is established.

There are many insects apart from the honey bee which effect cross-pollination. What then is the special importance of the honey bee in this respect, and why do progressive orchard owners regard the honey bee as almost indispensible? It is the purpose of this article to attempt to answer this question.

It is a recognised law of heredity that in-breeding makes for weaklings and fresh blood produces vigorous offspring. We find that plants in several ways try to prevent in breeding. A common method is that the stigma and the pollen of the same flower do not reach maturity at the same time (*e.g.* Salvia). Again, in other cases the stigmas are placed higher up in the flower so that its own pollen cannot fall on them. Often the female flowers are higher up in the branch than the male flowers (*e.g.* walnut), and self pollination is attempted to be avoided this way. Again some varieties have become completely self-sterile so that fruit and seed from their own pollen become impossible. Such is the case with many varieties of apples, plums, cherries, etc. Lastly, even in the case of self-fertile varieties, some observers state that pollen from other varieties is pre-potent over own pollen.

Such is the case for cross-fertilization. It does not rest on theoretical considerations only. It is the confirmed experience of fruit growers that cross-pollination produces better, bigger and more perfectly formed fruits. The writer has a limited amount of personal experience in this direction. In 1937 he placed some of his hives in an apple orchard. He found that the trees near the bee hives were laden with fruit of very good quality. On enquiry from the owner of the orchard he learnt that the trees had never borne such

fruit before. There were, however, no records of production in previous years and this naturally detracted from the value of the experiment. Later in 1939 the writer placed a number of hives in a Government Agricultural Farm where an accurate record of production was kept. The fruit affected was the strawberry. It was found that production increased from 840 lbs per acre in 1938 to 1255 lbs. per acre in 1939. Here also it can be said that the increase might have been due to some factor, or factors, other than my bees. But it may be mentioned that the fields in which the crop was grown, the strawberry plants, the system of management followed, and the person in charge were the same in both the years. The fields being irrigated the factor of rainfall is eliminated. Further, 1938 was no freak year.

The value of cross-fertilization being recognised it now remains to establish the supremacy of the honey bee over all other agents which effect cross-pollination. It will be readily conceded that wind, birds, rain, etc., are both wasteful and inefficient agents in this respect. We have, therefore, to consider only the comparative worth of insects other than the honey bee.

A detailed discussion would make this article much too long. It would be useful, therefore, to merely state briefly the points in favour of the honey bee.

(1) Flowers produce nectar and pollen both of which the honey bee seeks for food. Insects, other than the honey bee only seek nectar. All flowers do not secrete nectar. Thus the flowers which do not secrete nectar and have only pollen to offer, fail to be visited by insects other than the honey bee.

(2) There are some insects which have learnt the habit of robbing nectar from flowers without rendering any service in return. Entomophilous flowers, *i.e.* flowers which woo insects, usually keep their nectar well hidden from promiscuous robbers Some insects cut through the corolla of such flowers and rob it of its nectar. Here the flower loses nectar without obtaining any service in return. Had

the insect come by the legitimate route, its entry would have done what was needed. But when it takes the nectar from the outside by cutting through the corolla of the flower, it is causing injury without conferring any benefit. The honey bee is never guilty of this sort of robbery.

(3) Since the honey bee must take both pollen and nectar, it gets better covered with pollen and is thus a more efficient vehicle for the carriage of pollen from flower to flower.

(4) The honey bee has the habit of visiting the same species of flowers in one trip. This habit avoids wastage which occurs in the case of the other insects who visit flowers of unallied species indiscriminately.

(5) The size of the honey bee enables it to visit a majority of flowers. Most other insects can visit only a limited number of flowers. Again the hairs with which its body is covered make it a more efficient agent for carrying pollen.

(6) Many insects, like the wasp, puncture and destory a good deal of fruit and thus do a great deal of harm in the orchards. The honey bee is innocent in this respects.

(7) Bees being under the control of man, can be concentrated at will in any particular area at any desired time.

(8) In cool regions bees can be made available in early spring when other insects are not available in large enough numbers, as they die out in the winter.

We have seen how important the honey bee is in effecting cross-pollination. Apart from the benefits resulting from cross pollination, there is another reason why the services of the honey bee are so much in demand with fruit growers. Many fruit plants yield but very small amount of fruit owing to delay in fertilization through lack of sufficient insects. We will mention the case of the apple. The flowers remain in bloom for about 18 days. When the stigmas

reach maturity they are in a condition to receive pollen. During this period, *i.e.*, when the stigma is in a receptive condition, it is extremely susceptible to frost and other sudden climatic changes. If pollination takes place, the juices dry up and the stigma is no longer susceptible Thus inclement weather does not affect the fertilized flowers to any great extent. Lack of sufficient insects to effect pollination would mean that the stigmas would remain in this condition, exposed to a variety of dangers. Frost may kill off the stigmas, rain may wash off all the pollen or may render it impotent, and wind may dry up the stigmas before they have received pollen. The cause of unripe fruit falling down from branches has, in many cases, been traced to the exposure of the stigmas to such conditions. A large force of honey bees concentrated at the required time would eliminate the effects due to these dangers by effecting pollination at the earliest possible moment.

The intimate relationship of the flower and the insects cannot be better illustrated than by the following case. The figs of Smyrna are renowned throughout the world. The fruit growers of Califormia, U. S. A., decided to grow the fruit in their own orchards. Suitable plants were imported from Smyrna. When the time came, it was discovered that the fruit produced by these imported plants was no good. The orchardist were determined and did not give up. Technical men were sent again to Smyrna to study the question first hand. The secret was at last revealed, though it took the scientists 4 years of effort to unravel the mystery.

The fig though commonly called a fruit is really the receptacle in which flowers occur. It was found that parasitic hymenopterous insects crept into the fig and laid eggs which resulted in unsatisfactory fruit. In Smyrna cross-pollination was effected with the help of a wasp (Chalcididae Family) of hymenoptera. The resultant fruit was good because it did not fall before it was ripe The scientists, therefore, took from Smyrna this wasp and introduced it in the fig orchards at California. California now produces as good figs as Smyrna. Many other instances of the complete interdependence of a particular flower and a particular insect could be cited, but lack of space forbids.

THE PROVINCIAL MANGO SHOW, LUCKNOW

ORGANIZED BY
THE U. P. FRUIT DEVELOPMENT BOARD

BY

JOHN A. MANAWWAR, M.A., B.SC. (EDIN.), M.S.A. (TEXAS)

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The Provincial Mango Show was organized by the U.P. Fruit Development Board and was held at Lucknow from the 20th to 22nd July, 1940, in active co-operation with the Agriculture and other development departments, under the chief patronage of His Excellency the Governor, U.P. It was held in the Baradari Hall of the British Indian Association which is situated in the heart of the city among ideal surroundings. The Hall was tastefully decorated for the occasion with gorgeous palms, ferns, buntings and flags. At one end of the Hall a big Christmas tree of mangoes with multi-coloured bulbs was standing, and just above it a huge placard of white cloth with red border bearing the inscriptions "Provincial Mango Show, U. P. Fruit Development Board.'

The Show was divided into four sections as given below :—

1. Fruit and Fruit Product Section.
2. Commercial Section.
3. Demonstration Section.

and 4. Nursery Stock Section.

1. Fruit and Fruit Product Section.—This section was arranged in the main hall of the building. It included exhibits of mangoes of all types and descriptions arranged along the pillars in the centre of the hall, on the tables covered with red cloth. Other exhibits in this section consisted of

hill fruits, other fruits and vegetables and their products, such as canned fruits, jams, jellies, squashes, *achars*, *chutneys* and dried mango pulp. Most of these exhibits were received from exhibitors of this province, some consisting of pineapples, grape-fruits and canned and preserved fruits from the Provinces of Assam, Madras, Bombay, the Punjab and the Central Provinces. The competition in this section was so keen that the judges were at their wits' end in coming to their decisions especially in respect of mango exhibits.

2. **Commercial Section**.—Space in this section was allotted in the north wing of the building to the Co-operative Sale Societies, orchardists and approved agents and seed stores of the U. P. Fruit Development Board. Decorated stalls were put up by these agencies which attracted large crowds, and good business was done.

3. **Demonstration Section**.—The whole of the wing on the east side of the building was reserved for demonstrations by the various sections of the Agriculture Department and other agencies. Demonstrations and lectures in this section were arranged by the U. P. Fruit Development Board, the Plant Pathologist, the Agricultural Chemist, the Entomologist, the Marketing and Gardening Sections, the Botany Department of the Lucknow University, and the National Safe Deposit and Cold Storage Limited, Lucknow. Instructive lectures were delivered regularly and demonstrations were given on various subjects connected with the production and marketing of fruits, which proved very beneficial to the visitors. In the centre of this wing on a large table ocular demonstrations were given on the processes of making jams, jellies, *achars*, and in the canning of fruits This became a centre of attraction, especially to house-wives, college girls, and other ladies wishing to learn the art of fruit preservation and canning.

4. **Nursery Stock Section**.—Space on the south end was allotted to this section. Exhibits of mango grafts and of other plants and of packages showing the correct method of packing plants were received from a number of nurserymen in the province. The competition in this section was keen and some of these nurserymen received a number of orders from the visitors.

Outside the building on the platform, actual layout of a model orchard, proper methods of irrigation and planting were demonstrated on blocks of soil. The platform was beautifully decorated with ornamental plants and shrubs.

The show was opened formally on the 20th July, 1940, by P. W. Marsh, Esq., C.S.I., C.I.E., I.C.S., Adviser to His Excellency the Governor.

Mr. C. H. Parr, I.A.S., President of the Board and Director of Agriculture, U. P., in welcoming Mr. Marsh and the public made a brief review of the multifarious activities of the Board by tracing the progress and development of the work of the Board since its inception in 1935. Mr. Parr also thanked the donors who had contributed generously towards the award of prizes and other sundry expenses in connection with the show. In conclusion he mentioned some of the urgent needs of the Board, the chief among these being allotment of funds for the opening of a Central Nursery.

Mr Marsh declaring the show open congratulated Mr. C. H Parr, President of the Board and Director of Agriculture, U. P., and Mr. J. A. Manawwar, Honorary Secretary of the Board and Provincial Marketing Officer, U. P., for organising such a successful and instructive show which in his opinion would create considerable interest among the fruit-minded public. He remarked that he was pleased to find that the Board among its activities included all the recommendations of the Indian National Planning Committee. He emphasised the necessity of giving a practical emphasis to the slogan "Eat more fruits" by growing and selling fruits at a price at which a poor man could buy.

On the 22nd July, 1940, at 5 p.m., in the presence of a distinguished gathering Mrs. Horke (wife of a Judge, Chief Court, Lucknow) gave away the prizes.

There is not the least doubt that the show was a great success and is likely to be of immense value for the promotion and development of the Fruit Industry in these provinces. There were 800 entries from over 30 districts in the province besides those from other provinces. It was estimated that about 3,000 people visited the show daily.

A STUDY OF AN IDEAL VILLAGE IN THE CENTRAL PROVINCES AND BERAR

BY

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(Continued from the previous issues)

Chapter VII

People and their Social Customs.—The total population of the village in the year of study (1937) was 840. There were 176 families belonging to different casts. Thus the average heads per family come to 4·8. The following table shows the distribution of families according to different castes :—

Caste	No of families	Percentage	No. of members
Maratha	108	64 88	545
Mahar	37	19·75	166
Mang	10	6·31	53
Rajput	6	3 22	27
Barber	3	1·67	14
Mohammedans	4	1·63	12
Gosavi	2	1 07	9
Washerman	3	0·83	7
Carpenter	1	0 46	4
Wani	1	0·24	2
Brahmans	1	0·12	1
Total ..	176	100·00	840

From the above table, it is seen that about 65% of the total population consists of Marathis which is the most widely distributed caste in Berar. Almost all of them possess some land and carry on the cultivation. Mahar and Mang who are depressed class people, constitute about 26% of the

population. Both these castes form a labouring class in the village.

Kind treatment to the Depressed Classes:—The depressed classes are well looked after by the superior castes and have been given equal rights in the welfare and administration of the village. Thus the unity between the superior castes and the depressed class people is one feature of the village worth noting. The farmers realise that it is due to their hard labour that they can reap good harvest, and in turn these depressed class people also are aware of the fact that it is their hard and honest work which can raise better crops, enabling them to get more wages. This mutual understanding and co-operation is very easily recognized from the fact that even the poor depressed class labourers contribute one pice per rupee from their wages for the welfare of the village.

But the picture in other villages is not as rosy as it is in this village. There, the conditions are quite different. People from superior castes are very orthodox and do not even touch a depressed class man.

One Heart, One Mind.—This is the motto of the villagers and all of them try to stick to it. Once they determine to carry out some improvement, then all of them will strive hard to make that work a complete success. Due to this motto, there are no litigations which are usually a special feature of an Indian village. I can confidently say that an increasing number of litigations and the abolition of the *panchayats* are the two most important causes which have led to the deterioration of the villages. Whenever there is any meeting, every villager attends it very enthusiastically and gives a patient hearing to the lecture. Every villager looks to the welfare of his neighbour and helps him in every respect, both physically and mentally.

Sanitation.—Strict sanitation is maintained by the *panchayat*. Any defaulter who goes against the rules of public sanitation is fined. Separate arrangement of latrines for males and females have been made. Areas are reserved for this purpose and nobody is allowed to commit nuisance anywhere else. All the manure is put in the pits which are away

from the dwelling houses. From time to time, the villagers are given lessons in personal hygiene and its importance

Health.—As every villager is fully aware of the value of good health, he does not fall an easy prey to any diseases. In order to check the occurrence of epidemics, every preventive measure is taken by the 'Kisan Aushodhalaya'. Child welfare work is encouraged by holding baby shows from time to time, and by giving prizes to the most healthy children. Free medicine is given by the Dispensary to all the villagers. In the rainy season when the chances for epidemics are more, they are given proper instructions as regards their food and water. At different places posters having sanitary rules are put for their information. On the whole, the general health of the people is more satisfactory than the villagers of the surrounding area who are always attacked by various diseases and fall an easy prey to epidemics due to their unsanitary conditions of living.

Standard of Living.—Nowadays, the progress of any country is judged by the standard of living of the people in the country. In the same way, the progress of a village also can be judged by the same standard. In this village, practically all the people are completely dependent on land. Taking into consideration the whole population of India, it has been estimated that only 25 per cent. can get both meals, 50 per cent. only one meal and the rest remain half starved. But this is not the case in this village. The majority of the people take their meals thrice and the rest twice a day. The meals consist of *roti*, *dal* and some vegetables and is fairly nutritious.

As regards clothing also they are not in any difficulty. Even the poor also have sufficient clothes. There are two or three festivals like *Divali* and *Dashra* in a year on which even the poor buy new clothes. However, in winter the poor do not get sufficient warm clothes. Now, in the matter of housing, it is practically the same as in other villages, except that they have improved sanitary condition. There are no masonry buildings except Rao Bahadur Patil's house, the school buildings, the temples and the Chaodi. Knowing the importance of sanitation, the people do not

keep their cattle in the same house in which they live, but provide for a separate shed.

Savings.—The 'Kisan Stiti Sudharak Sanstha' serves as the Peoples' Bank in the village, and takes deposits from the villagers. The Society gives an interest of four per cent over the current account and five per cent. over the fixed deposit. This facility has naturally encouraged the habit of thrift and economy amongst the villagers. Besides this, there is also a saving bank of the post office, in which many people have deposited small sums. Thus the people have about Rs. 4,000, in both the saving banks, which save them from the clutches of the money lenders. Besides this, every family has got some saving in the form of silver aud gold ornaments which amount to about Rs. 20,000.

Indebtedness.—Indebtedness is the special feature of the rural economy all over India, and this village also is not an exception to this rule. But the debt in this village is small and is not borrowed from any Marwari or Bania. The majority of the loans are taken from the Kisan Pedhi and Rao Bahadur Patil at a moderate rate of interest which varies from nine to twelve per cent according to the financial position of the farmer.

The total debt in the village amounts to about Rs. 8,000, which comes to about Rs. 45 per family, while that of C. P. and Berar comes to Rs 227. Before the establishment of the Kisan Pedhi (*i.e.*, The Farmers' Bank), the village was very heavily indebted to the Marwaris and Banias of the surrounding villages. Formerly the total debt amounted to about Rs. 28,000 which have now been paid up due to the economic habits of the farmers.

"The cultivation of the earth is the most important labour of man. Unstable is the future of the country which has lost its taste for agriculture. If there is one lesson of history that is unmistakable, it is that national strength lies very near the soil."

DANIEL WEBSTER.

A Book Review

"An Outline of Indian Agriculture" by R. G. Allan, M. A., C.I.E., Commissioner of Agriculture, Baroda State, is a handbook full of useful and important information on general agriculture In the words of the Dewan, Sir V. T. Krishnama Chari, in the foreword, the book "gives a bird's eye view of the fundamental problems of Indian Agriculture, a useful and necessary background for the study of problems relating to individual areas." The author starts with the distribution of crops in India, then gives a brief account of principal crops all from his experience and knowledge about the Indian farmer. In one chapter while describing the farmer's working outfit, he says, "With this very simple outfit and a good deal of manual effort the many million acres of India's land are tilled and the many millions of tons of produce referred to earlier are annually created." After this the author comes to what may be called the other side of the picture which is full of hope of future development of agriculture in this country. Here he deals with different agencies created by Government for the improvement and welfare of agriculture and its allied branches. He gives an account of the Agricultural Department and different improvements made by it. In other chapters he describes Indian live-stocks, the increase of water supply, and concludes by giving a very valuable synopsis of the disposal of agricultural produce.

The printing, get-up, and binding of the book is excellent and the cost of this publication of 171 pages is Re. 1-8 only. It is suited to every pocket, and every agricultural student, and agriculturist should be in possession of a copy. It is bound to have a wide circulation.

K. K. MISRA.

Milk bottles and jugs are more easily cleansed if rinsed out with cold water first. Milk should never be given to children in metal cups of any kind.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, U. P.

For May, 1940

I—Season.—Light and scattered showers were received in the first half of May, 1940, but the rainfall in the second fortnight was general throughout the province. It was above normal in 10 districts, 2 districts recording above 2 inches and 2 over 1 inch.

II—Agricultural Operations.—Agricultural operations are generally up-to-date. Irrigation of sugarcane and extra crops and preparation of land for *Kharif* crops are in progress.

III- Standing Crops and IV—Prospects of the Harvest.—The condition of the standing crops is satisfactory and the prospects are so far favourable.

V—Damage to Crops.—No serious damage to crops is reported.

VI—Agricultural Stock.—The Agricultural stock is in good condition. The following cattle diseases have increased to some extent as will be seen from the following figure furnished by the Director of Veterinary Services, United Provinces :

Diseases	April, 1940		May, 1940	
	Seizures	Deaths	Seizures	Deaths
Rinderpest	3,002	1,586	3,137	1,467
Foot-and-mouth	5,081	42	7,196	47
Hæmorrhagic Septicæmia	42	40	63	54

VII.—Pasturage and Fodder.—Fodder and water are reported to be sufficient everywhere.

VIII.—Trade and Prices.- Prices of the chief food grains except gram and rice have further fallen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month:

			End of April, 1940	End of May, 1940
Wheat	...	...	3·725	3·514
Barley	...	...	2·680	2·614
Gram	...	...	3·268	3·323
Rice	...	...	4·865	5·055
Arhar dal	...	...	4·644	4·496

IX.—Health and Labour in Rural Areas.—The condition of agricultural and labouring classes is generally satisfactory. Cases of small-pox, cholera and out-break of fire are reported from certain districts.

FOR JUNE, 1940

I.—Season.—Rainfall in the first week of June, 1940, was general though light; in the second week only scattered showers were received. The monsoon however became more active in the last fortnight. The total rainfall of the month was throughout the province below the normal with the exception of Dehra Dun where it was above normal. A statement showing rainfall by districts is appended.

II.—Agricultural Operations.—Agricultural operations are in progress. Preparation of land for and sowing of *kharif* crops continues. Irrigation of sugarcane and extra crops is going on where necessary.

III.—Standing Crops and IV.—Prospects of the Harvest.—The condition of the standing crops is satisfactory and prospects are favourable.

V.—Damage to Crops.—No damage to crops is reported.

VI.—Agricultural Stock.—The condition of the agricultural stock is satisfatory. Rinderpest and foot-and-mouth diseases have both declined to some extent while Hæmorrhagic Septicæmia has slightly increased as is indicated by the following figures furnished by the Director of Veterinary Services, United Provinces :

Diseases	May, 1940		June, 1940	
	Affected	Deaths	Affected	Deaths
Rinderpest	3,137	1,467	2,823	1,229
Foot-and-mouth	7,196	47	3,278	18
Hæmorrhagic Septicæmia ..	63	54	94	75

VII—Pasturage and Fodder.—Fodder and water are reported to be sufficient everywhere.

VIII—Trade and Prices.—Prices of the chief food grains expect rice have further fallen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

	End of May, 1940	End of June, 1940.
Wheat	3·514	3·425
Barley	2·614	2·596
Gram	3·323	3·168
Rice	5·055	5·110
Arhar dal	4·496	4·365

IX—Health and Labour in Rural Areas.—The condition of agricultural and labouring classes is generally satisfactory. Cases of small-pox, cholera and outbreak of fire are reported from certain districts.

FOR JULY, 1940

I—Season.—The rainfall during the month of July, 1940, was general, but on the whole below the normal, only seventeen districts recording above normal rain. A statement showing the districtwise distribution of rainfall is appended.

II.—Agricultural Operations.—Agricultural operations are generally up-to-date. Preparation of land for *rabi* and sowing and weeding of *kharif* crops continue. Transplantation of late rice has been started.

III.—Standing Crops and IV.—Prospects of the Harvest.—Condition of the standing crops is so far satisfactory and the prospects are favourable.

V.—Damage to Crops.—There is nothing to report under this head.

VI.—Agricultural Stock.—The condition of the agricultural stock is satisfactory. Mortality from rinderpest and foot-and-mouth diseases has declined appreciably, but from hæmorrhagic Septicæmia it has considerably increased as is indicated by the following figures furnished by the Director of Veterinary Services, United Provinces :

Diseases	June, 1940		July, 1940	
	Affected	Deaths	Affected	Deaths
Rinderpest	2,823	1,229	1,732	659
Foot-and-mouth	3,278	18	1,975	2
Hæmorrhagic Septicæmia	94	75	1,031	817

VII.—Pasturage and Fodder.—Fodder and water are reported to be sufficient everywhere, but the District Officers of Etawah, Jalaun and Fyzabad Districts have reported that there is no pasturage available in their districts.

VIII.—Trade and Prices.—Prices of the chief food grains except *arhar dal* have risen slightly. The following figures compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

			End of June, 1940.	End of July, 1940.
Wheat	...	...	3·425	3·517
Barley	...	...	2·596	2·659
Gram	...	...	3·168	3·317
Rice ...	...	...	5·110	5·191
Arhar dal	...	...	4·365	4·207

IX.—Health and Labour in Rural Areas.—The condition of agricultural and labouring classes is generally satisfactory. Cases of small-pox and cholera are reported from some districts.

DATE

The nourishing properties of dates are well known. They are easily digested, and for this reason are often recommended to consumptive patients.

According to Dr. Fernie half a pound of dates and half a pint of new milk will make a satisfying repast for a person engaged in sedentary work

(FOOD REMEDIES).

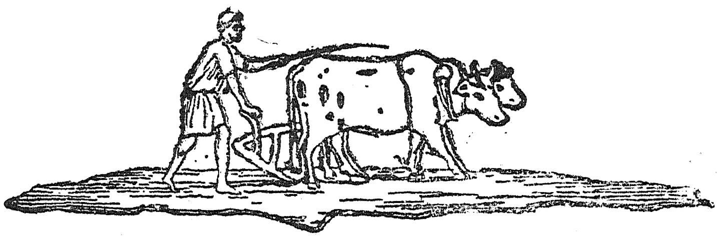
RASPBERRY

Raspberries are excellent against the scurvy, and like the blackberry, good for relaxed bowels. They are a very wholesome fruit, and should be given to those who have "weak and queasy stomachs."

(FOOD REMEDIES).

THE

ALLAHABAD FARMER



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Editorial

Shall I buy a tractor?

Several letters have come to us asking us this question whether they should or should not buy a tractor. The answer to this question depends on several things. But first of all let us clear the minds of our readers from certain misconceptions by explaining to them what a tractor is. A tractor is simply a source of tractive power or of draft. Occasionally it is also used as a source of stationary power, as in using it instead of electricity for cutting fodder or for pumping water. It is therefore a machine which is used for drawing ploughs, harrows, and other tillage implements on the farm. In this way its work in this country may be compared with that of bullocks, except that the tractor is so much more powerful than either bullocks or horses. So the tractor itself does not till the soil except as different kinds of tillage implements are attached to it. The reason therefore for buying a tractor is to supply tractive power on the farm either because other tractive powers, such as bullocks or

horses, are not available or because they are insufficient. This is more especially true of large farms where a large acreage cannot be covered in a short time, that is during the sowing season, because of the insufficiency of bullocks.

One must remember therefore that the tractor itself does not in any way improve the efficiency of cultivation of the soil, except as more efficient tillage implements are attached to it. That is, the increase in the tractive or draught power does not improve the efficiency of the cultivation of the soil.

In order to make this clear we may point out that horse draft is not any better than bullock draft although the former is much quicker than the latter and is thereby able to do much more work, that is in the matter of tillage. It only depends on the kind of tillage implement which is attached to the horse or to the bullock. Shall we also say in this connection that there is a general belief in this province, a believe which is erroneous, that an increase in the size or the weight of the bullock results in improved cultivation. This belief has also resulted in the policy in this province of breeding bigger and heavier bullocks, which, as we know are not always welcomed by the cultivator, because they do not meet his requirement.

The motive therefore for buying a tractor is to either replace the bullock power or to supply the inadequacy of bullock labour, or to have a power which is so much more powerful than that of bullocks so that it can be used for such operations on the farm as are too difficult for the bullocks, such as the uprooting of trees, deep ploughing for *kans* eradication, etc. The important criterion which usually determines the answer to the question as to whether one should buy a tractor or not is whether the tractor is a better substitute for draft than bullocks, and also whether the bullocks available are not adequate to cope with the farm work during the busy seasons of the year. For a farm which is engaged in the growing of various kinds of crops we doubt very much whether a tractor would be an economic proposition if the area of the farm is less than 200 acres. This figure however depends on other factors, such as

the degree of intensity adopted on the farm, the availability of water for irrigation, etc. One should also work out the probable investment on bullocks and compare it with that for a tractor. As a rule with a farm using modern farm implements in this province, a good pair of bullocks should be able to take care of 10 acres, and while bullocks have to be fed throughout the year the cost of depreciation of a tractor is also quite high. But a tractor has also this advantage that it can be used up to 18 hours a day whereas bullocks cannot be used for more than 8 hours a day.

Another very important consideration is the availability of capital Where capital is scarce, the investment on a tractor will usually prove to be uneconomical. In Farm Management, the principle which one should constantly bear in mind is that one should always make the best use of the scarcest factor of production. That is where capital is scarce, greatest care must be taken in using it to the best advantage. Where labour is scarce, labour must be used very efficiently. That is why the use of a tractor in America is almost universal. The tractor contributes to the efficient use of labour which is the scarcest factor of production in that country.

Of the four usually recognized factors of production, namely land, labour, capital and management, we would say that with an Indian cultivator, capital is the scarcest. There are af course other circumstances which may change the situtaion. We may for instanc› have a high-powered farm manager who may be capable of managing a 2000 acre farm, and consequently whose salary may be say Rs. 500 or more. It would be a mistake to use him therefore on a 100 acre farm. That would not be using the best use of that factor of production, namely management. Such a step will in all probability result in a loss to the farm or at least a reduced profit.

The use of a tractor is therefore to be recommended to zamindars and landlords of this country as they have plenty of capital and a large area to cultivate. But we should not be in a hurry to recommend it to the poor cultivator even though he may be able to buy one by pooling his resources with his neighbours.

SILO AND SILAGE

BY

SAM HIGGINBOTTOM

I have been making silage for the last thirty-five years; first in the Naini Leper Asylum. Then as soon as the Agricultural Institute got possession of its land in 1911, one of the first things done was to dig a silo pit 20 ft. in diameter and 20 ft. deep. Lengthening the radius 6 inches every 90 degrees gave a spiral path 2 ft. wide upon which the coolies can carry out the silage as it is needed. All that was needed to empty the silo was taking off the top layer of silage evenly. A round silo is less wasteful than a square or rectangular one. Corners are bad because silage cannot be pressed down.

Where a good many cattle are to be fed regularly at a given place, and the water table permits, the putting in of an underground silo of this kind, with a roof over it, will be as economical as any. Our silos are laid in well-curb shaped brick, 9×6×3 of the right diameter, laid in mud, as the acid in the silage will gradually eat out the lime in mortar. Such a silo is much cheaper than an overhead silo of the same capacity. For filling such a silo we have a Papec Silage cutter which cuts the fodder into three-quarter inch lengths.

We plant *juar* (sorghum) with the first rains in the beginning of the monsoon, usually the first week of July. We begin to fill the silos about the first of September as we usually wish to get the fields ready for a *rabi* (winter) crop. The fodder by this time is not fully matured and therefore it has a higher feeding value (not so much fibre) than matured plants have. *Juar*, *bajra*, (pearl millet) maize, Napier grass and Guinea grass are all useful for silage, though Napier grass alone is not as good as when it is mixed with some other fodder crops, as maize, as it tends to have too much moisture. Some years we put

30% of American cow-peas or guara with the *juar* which greatly improved the feeding value. This showed itself in the improved condition of the cattle. I know nothing simpler or easier than having good silage if a few simple rules are followed. It is desirable to put the fodder in the silo within 36 hours of its being cut in the field. As it is cut into the silo it should be levelled in the silo pit, as, if it is left in cones, irregular, and later on levelled, it almost invariably results in layers of mouldy silage. The secret of good silage is the exclusion of air from the container. This can best be done by cutting the silage into short lengths and tramping it as it comes in.

In addition to underground and overhead silos, good silage can be made in trenches such as are now in use in government military farms, 10 to 12 ft. deep, 8 to 10 ft wide at the bottom, 12 to 14 ft. wide at the top with sloping ends, as long as seems wise, from 30 to 100ft. so that a cart may go through it. Into these trench silos can be put grass or fodder. In many places the trench silos are filled with uncut fodder; but I believe it is more economical where the fodder is cut with a machine as there is less waste. Also where fodder is uncut, it is difficult to take out, as it seldom settles evenly. Also the disturbing of the cured silage often causes mould.

I have also made stacks of railway line grass, beginning to cut in August and continuing through October. If such a stack can have a roof over it, excellent silage will come out of it.

After the silo has been filled it is better to give it anything from six weeks onwards for ripening and fermenting. In the Naini Central Jail, the late Colonel Hudson put down a lot of pits 10 ft. in diameter by 16 ft. deep. He hoped that one of these pits could be opened each year for the next fifty years to see how long silage would keep. Each year, before the rains, care was taken to see that the top of the silo was so arranged as to shed water. I was fortunate enough to see one of these silos opened each year with one or two exceptions for ten consecutive years. The silage

taken out the tenth year was just as good as the silage taken out the first and the second years.

There is a certain loss always, when fodder is put into a silo pit. But I know of no way of storing fodder that has not involved a loss of fodder. My experience is that there is less loss by way of the silo pit or trench or silo stack than storage in any other way. In addition the silage is palatable and greatly relished by the animals. Many weeds, leaves of trees, and grasses like *kas* and *kus* which the cattle ordinarily will not eat, are made palatable and eatable by being cured as silage and are eaten with great relish. Our silos are usually being filled from about the first of September to the middle of November. Anyone who wishes to see this process can do so during that time. Also in the hot weather we grow under irrigation quick growing catch crops like *bajra*. After about six weeks growth, put it into the silo in June or July. This makes excellent fodder which the cattle relish when it is difficult to get anything green. We put up on the average over fifty thousand maunds of silage.

I am surprised that there is still in India so much scepticism regarding the value of the silo and silage. If the government military dairies have made it a part of their practice for as many years as we have been doing it here in the Institute, there must be something to it. We would not know how to carry on without the silo Years ago I advocated that, like Joseph in Egypt, in the years of plenty, the years when grasses are abundant, they can be stored in *kuchha* silo pits or trenches and with very little care, could be kept over for the years of scarcity which we know are almost certain to recur, entailing terrible cattle losses in areas where the fodder fails. I know of no other way so cheap and economical of providing an abundant supply of palatable cattle food as the silo. I sometimes refer to the silo as the fodder bank. You put the fodder in when you have it, and it is perfectly safe there if properly put in, until you need it years later. Nothing else I know is such a guarantee for the security of food supplies for cattle.

CROP IMPROVEMENT BY BREEDING FOR DISEASE RESISTANCE

By

M. P. Singh, M. Sc.

Fomerly Cotton Research Officer, Rangamati, Chittagong Hill Tracts

Life in the course of its manifestation is subject to pathological disorders. The result of such disorders is obvious, either the extinction of the life or recovery takes place. In the latter case there is a temporary setback in the normal functions of life. Plants like animals are not free from such pathological disorders. Amongst plants in the case of recovery from the disease, a sort of permanent change reflected in diminished performance of yield is brought about, due to the loss of vigour which the plant finds difficult to make up during its short life time. This has been the experience at least with plants of annual habit. Diseases of only crop plants will be dealt with here, and that also of wheat and cotton especially. The principles governing the methods of breeding for disease resistance are not much different than those of the above two crops; the difference, if any, is more in the details rather than in principles.

The extent of damage caused by diseases.—Plant diseases are mostly of fungoid origin, which start their life on the host plant first as a saprophyte and then later on become parasitic as in the case of wilt disease in cotton. The infection takes place by means of fructifications of the fungus, and the source of the infection is either soil or air. The infection travels in the plant either through a wound, or stomata. The fungus as it develops within the tissues of the host plant chokes the xylem vessels, or favours the development of ligneous tissues which hamper the normal activity of the plant. As a result of these changes in the plant, symptoms as discoloration of roots, mottling of the

leaves, appear and if the attack is more virulent the plant wilts and consequently dries up leaving behind bare stick sticking out of the soil.

In the case of wheat rust fungus which gains entry into the plant through the stomata, the development of the pathogen takes place under the epidermis, and the cortex gets completely filled up by the fungus, and fructifications appear on the surface by rupturing the epidermis. The chlorophyll in the leaves gets deficient, and due to the inadequate food manufacture the grain setting is meagre. At times when the disease intensity is great the damage caused by the wilt of cotton is so great that tracts are swept clean of any living plant, and no crop is produced. Butler estimates that the average annual loss to the wheat crop alone by the yellow rust is approximately four crores of rupees. The extent of the damage caused to the above two crops alone by the disease, is sufficient to convince any one regarding the utility of combating the disease menace with a view to effect improvement.

Means of Combating the Disease.—The means adopted to combat the disease menace can be classified mainly under four heads *viz.*, chemical, agricultural, botanical, and legislational.

The chemical means of combating the disease consists of spraying the infected plant with mixtures which are fungicides with a view to kill the fungus, and also to check its further growth. The method has met with large success in cases where the number of plants is not very large, as is the case in horticultural practice. It is not of much use in cases of crop plants where large number of individuals are concerned, as, besides crossing the limits of practicability, it will be also expensive. Besides, the fungicides used are liable to injure the plants as they are rather delicate, and make the produce unwholesome due to the poisonous nature of the chemicals used.

Agriculturally the disease is controlled by taking resort to clean cultivation, and making use of the disease free seeds for sowing by disinfecting them, which will eliminate seed borne diseases. The practice of leaving the disease infected plots fallow with a view to cross the longevity of the disease

spores in the soil, and to take resort to exceptionally deep ploughings during the season when the temperature conditions are adverse to the development of disease, are means to the same end. This method of combating the disease has little advantage in cases where the infection is air borne as has been found to be the case both in wheat and cotton.

The passing of such legislation as prohibiting the import of agricultural raw material into a country without proper disinfection is a way that has kept out successfully many of the diseases of crop plants of other countries. Absence of cotton stem borers in India, a source of great annoyance in other countries is by virtue of such steps.

Botanically the way of combating the disease consists of evolving plants which will escape the period when the disease gets active, a period which is only determinable by the close study of the pathogen along with its relations to other plants during its life history. The discovery of alternative hosts of the disease and their consequent destruction has played an important role in checking the disease.

The expectations of the above methods were not realised to the extent anticipated, though some of the achievements have been quite outstanding

The problem of combating the disease menace has come to be now tackled genetically, especially with the discovery that resistance to disease is a Mendelian character The pioneer work in this direction has been that of Biffen, now Sir R. H Biffen, who showed that resistance to rust was due to a single factor with susceptibility as dominant to resistance. And by crossing a susceptible variety with an immune type he could produce a new type named as Little Joss which was resistant to yellow rust. Even before this discovery it has been the experience of the breeders that the different components of a crop differ in their capacity to resist disease, a capacity which persist from year to year, and Mr. Willam Farrer of New South Wales in pre-mendelian days had bred a variety named Babos considerably immune to black rust.

Genetics of Disease Resistance.—Biffen found unifactorial seggregation in a cross between American Club wheat,

and Michigan Bronze, for resistance to yellow rust, the actual number in the F_2 being 1609 susceptible and 523 as immune. Susceptibility was found to be dominant to immunity as aforesaid, and larger number of susceptibles in F_2 bear out very well the dominant nature of susceptibility.

The state of affairs in cotton for resistance to wilt have not been so clear-cut as in the case of wheat. Fahmy who first propounded a unifactorial explanation for behaviour of the disease resistance, later on produced evidence (1934) that a single factor was not concerned, but multiple factors.

On a unifactorial hypothesis one type of behaviour should occur, 50% must breed true and 50% must seggregate in the F_3 whereas from Fahmy's data in F_3 immunity from 5—95% is come across. Moreover the behaviour of the fourteen F_4 families raised from resistant F_3 plants show that single factor is far from being concerned. Out of the fourteen F_4 families only one showed complete absence of immunity, and six families showed 50% immunity. Hutchinson (1937) has shown that all the available data could be reconciled assuming 10 factor pairs of equal value for resistance, giving a maximum of 20 genes in a homozygote with the greatest resistance. On the multifactorial hypothesis the varying reaction of the different progenies, depending upon the number of factors carried for resistance becomes clear. It will therefore be realised that the problem of breeding for disease resistance is not so clear-cut as it appeared before. Multiple factors are involved and the efforts have been to breed types which carry the maximum aggregation of resistance factors.

The degree of resistance to which the types are to be bred.— The ideal of complete immunity is decidedly the best and should be worked up to, but in view of the multiplicity of the resistance factors involved the chances of isolation of such a type besides getting meagre, also get expensive and laborious. Furthermore the disease in plants is due to the interaction of the 'plastic host and plastic parasite' modified by environment, and the genotype resistance is in a state of delicate balance with the disease virulence. This balance is very likely to break down due

to small differences of in say seed weight either in the host or parasite. To ensure against such differences is very difficult and almost impossible. Even under most favourable environmental conditions, and with the most uniform genetical material such differences are to be expected, and it is on account of these little differences, that the partial failure of immunity amongst the homozygotes so commonly experienced results.

Besides, the commercial characters are equally important or sometimes more important than 100 per cent. immunity, and the strains showing a little mortality due to disease, but otherwise in possession of economic characters should be encouraged rather than held up due to lack of complete resistance for disease. In such cases working up to complete immunity may mean sacrifice of the quality. Though this has not been established so far, but there is evidence that correlation between plant characters as earliness, (Ware 1932a) and root characters (Ansari—unpublished) and disease resistance exists.

On account of the aforesaid considerations, the conference of the scientific research workers on cotton on India held at Bombay, in 1937, was led to pass unanimously a resolution that "foragricultural distribution resistance of the order of 95 per cent under heavily injected field conditions is satisfactory, provided that the strain has been tested and shown to be practically homozygons for that degree of resistance to wilt." It will therefore be seen that for practical purposes resistance of the order of 95 per cent. in breeding for disease resistance will do.

Breeding procedure and difficulties. -Needless to say that the aim in breeding for disease resistance is the isolation of a type carrying the maximum aggregation of resistant genes. With this end in view the selections are made from sites which are known to be heavily infected by the pathogen. In the latter stages the disease intensity is made more virulent by taking resort to artificial infections either by infecting the oil or using the spare suspensions of the pathogen and spraying it on the plants at different stages of growth, as in the case of *[icu]laria Oryzae* in rice (Ramiah).

Hybridization is resorted to in cases where simple selection fails to produce a type of desired immunity to disease, with a view to isolate a type with greater number of disease resistant factors. Genetic variability of the pathogen plays an important role in breeding for disease resistance. Fortunately in the case of cotton wilt, *Fuzarium vasinfectum*, there was found to be no difference of pathogenicity in the various collections of the fungus, (Uppal 1937) and this absence of selective parasiticism in cotton wilt fungus greatly simplifies the problem of producing resistant type. In the case of yellow rust fungus of wheat selective parasiticism has been found to be the case, and it differs in its nature with locality and season. Stakman and Piemeusel (1917) in America recognised at least fifty physiologic forms of rust. New forms from time to time may continue to be produced and Craigie (1931) has shown that hybridization between different forms may take place in the aecidial stage, thereby producing new forms of rust. Breeding of a type resistant to all these physiologic forms seems to be no easy task, but the production by McFadden in America of H-44-24, and Hope, immune to, or nearly so to all the known physiologic forms is sufficient to indicate that the presence of numerous physiologic forms is no setback in breeding for disease resistance, and all the physiological forms may be regarded as one from the breeding standpoint. In India too, three or four physiological forms of rust have been recognised and in the absence of their larger numbers, it is encouraging to note that hope is being entertained to produce resistant types to all these forms.

Several objections have been put forth by Uppal (1937) in the method of selection in the fields. The variation in the condition of infection and the relation of edaphic factors to the development of the pathogen under field conditions all favour the selection of apparently immune types. It has been shown that the air and soil temperature have a very great influence on the development of wilt disease in cotton. Under adverse conditions resistance resembling the immunity to disease, due to genetical causes is introduced, and the chances of multiplying the disease escape types are enhanced under ordinary field conditions. Moreover the variation in

the degree of infection of the experimental site, and the shifting nature of the disease zones in a field all tend to encourage the selection of really non-resistant types. Faced with such a set of circumstances Uppal stressed the inadequacy of the field selections saying that they do not differentiate between disease resistant and disease escape types, and proceeded to show the necessity of a standard environment where more reliable and comparable results could be obtained. He held that breaking up of the disease resistant strains on the change of environmental complex was more especially due to a mixture of such apparently resistant types, and advocated the necessity of a technique which would eliminate the inclusion of apparently resistant types. The validity of field selections for disease resistance is a controversial question, Rao Sahib G. L. Kottur claims to have isolated from field conditions strains possessing 95 to 99 per cent. resistance, which did not break down, and maintained the above degree of resistance.

The inadequacy of the standards of testing was also realised by Hutchinson, and the use of replicated progeny row method with a view to eliminate the major differences of the experimental site between blocks and the minor differences of a block into different progenies was advocated. If the progenies under this arrangement showed significant differences between disease resistance then they really differed in their power to resist the disease. This method not only minimised the chances of inclusion of disease escapes, but also assured against the seasonal variation in the intensity of the disease attack. For, if the progenies responded to an attack of slighty lower disease intensity but otherwise uniform and high, it was also very likely to respond when the attack was more intense. The method of testing as advocated by Dr. Uppal was to test the field selections, selected for greater resistance to disease in pots in a green-house where the intensity of the attack was more intense, and could be controlled. The selections of the glass house were again to be retested under the field conditions on a larger scale. By this method it is claimed that cotton plants showing complete immunity have been isolated.

Besides the standards of testing, another difficulty in view of the mult ple factors involved in the inheritance

of disease resistance is that of testing for homozygosis. At what stage should the breeder conclude for certain that his strains have attained desired degree of homozygosis, and he can put them out without much danger of seeing them breaking down? The difficulty has been got over by Hutchinson (1937). Cotton plants show three types of reaction to wilt disease, some are attacked, some show mottlings and discolorations of the leaves, roots, etc., but produce a crop, and some are killed, at any stage from seedling to maturity. On this behaviour the plants have been classified by Hutchinson into free, surviving, and killed. A pure line is expected to give one type of reaction in an environment Attainment of a constant environment is difficult. What can therefore be done is to minimise the environmental variation. Small fluctuations due to initial differences of seed and embryo weight will persist even in a homozygons type. In testing for homozygosity in the above three classes of free, surviving, and killed, all that is needed to know is whether the significant differences between the free and the surviving classes is due to genetical or environmental causes. The absence of significant differences between the free, surviving, and killed classes may be taken to be due to environmental causes. Significant differences between free and surviving classes is due to genetical causes, as the surviving class carries a greater number of seggregates carrying fewer number of resistant genes than the former. This test can be easily applied to Hutchinson and Panse's replicated progeny row technique under heavily infected soil conditions.

Compact family blocks can be laid with advantage when a number of families along with their progenies are available, and the test for heterogenity can be applied by Stevens' formula described already in the first article of the series. The material thus selected should be then tested in pots under conditions of severe infestation by the Pathologist, and the simple $\chi 2$ test for homozygosity described by Hutchinson (1937) may be applied.

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According to the livestock statistics of 1935 for British India (excluding Bengal, Bihar and Orissa), the number of cattle in 1935 was 52 lakhs more than that in 1930—an increase of 4·9 per cent in five years.

In all things do your best. The man who has done his best has done everything. The man who has done less than his best has done nothing.

CHARLES M. SCHWAB.

A SHORT NOTE ON BUCKWHEAT

BY

S. CHOWDHURY

Buckwheat is extensively cultivated on the temperate Himalaya and lower Hills of India, from Afghanistan and Kashmir to Darjeeling, Assam and Burma. Though not a graminaceous crop, buckwheat is classed among cereals.

The name 'buckwheat' seems to be a corruption of the German 'buchweisen' meaning beech-wheat, a name given to the plant because of the shape of the seeds being similar to that of the beech nut; while their food constituents are similar to those of wheat grains. Botanically buckwheat is not a cereal; it is a member of the family *Polygonaceae.*

Fagopyrum esculentum Moench or the common buckwheat is the most valuable and the most widely grown form. It is met with wild in China and Siberia and enters into the agriculture of every country where grain crops are cultivated. In China it has been grown and used for food from time immemorial. In Japan it is held in general esteem and in Russia it is also largely consumed. It has been cultivated for centuries in England, France, Spain, Italy and Germany. In India it is grown on the lower Himalayas between 4,000 and 10,000 feet. In Northern and Eastern Bengal, Assam, Burma and even in the Deccan, the Central Provinces and Bihar, it is often met with as a catch or garden crop, where it is used as a vegetable or fodder.

F. Tataricum Geartn., the Tartary buckwheat, India wheat or Black wheat is cultivated in the cooler and more mountaineous regions of Asia and to some extent in Canada and the United States of America. In India it is cultivated throughout the higher temperate Himalaya, especially on the western extremity between altitudes of 9,000 and 15,000 feet. It is a taller, coarser plant than *F. esculentum*, having longer grains of a black colour.

Botanical Characteristics.—Buckwheat is of erect habit, under ordinary conditions attaining about three feet in height. The root system consists of one primary root and several branches. The stem varies from one-fourth to five-eighths of an inch in diameter and from green to purplish red in colour while fresh, changing to brown at maturity. Only one stem is produced from each seed; the plant instead of tillering or producing suckers, branches more or less freely, depending on the thickness of seeding. The leaves are alternate, triangular heart-shaped, slightly longer than broad varying from two to four inches in length and borne on a petiole varying from very short to four inches in length.

The flowers are white tinged with red or pink, and are borne on the end of the stem, or on a slender peduncle springing from the axil of the leaves. They are without petals, but the parts of the calyx have the appearance of petals and the bloom is so abundant that fields of buckwheat make a beautiful appearance. There are eight stamens and one three-parted pistil.

Two forms of flowers are produced: one with long stamens and short styles and the other with short stamens and long styles. Though each plant bears but one form of flower, the seeds from either form will produce plants bearing both forms. This arrangement is thought to facilitate crossing by means of insect visitation.

The grain of buckwheat consists of a single seed enclosed in a pericarp which in Botany is known as akene. The pericarp or hull is thick, hard, smooth and shining, and varies in colour from a silver gray to a brown or black. In form the grain is a triangular pyramid with a rounded base, The usual length of the grain is three-sixteenths to three-eighths of an inch and the width one-eighth to three-sixteenths of an inch.

The grain of *F. Tataricum* is smaller than the common or true buckwheat, the plants are more slender and the leaves arrow-shaped. The flowers are small and greenish and are borne in axillary mostly simple racemes along the stem.

Culture.

Climate.—A moist, cool climate is most favourable for buckwheat although seeds will germinate in a very dry soil, and considerable heat during the early stages of growth is an advantage. High temperatures during the period of seed formation especially hot sunshine following showers, is usually disastrous to the yield, causing blasting of the flowers. The yield is much reduced by drought during this period Buckwheat will mature in a shorter period than any other grain crop, eight or ten weeks being sufficient under favourable conditions It is thus well adapted to high altitudes and short seasons but its period of growth must be free from frosts as the plants are very sensitive to them.

Soil.—Buckwheat will grow on a wide range of soils, but those of a rather light well-drained character are best suited. It will give fair yield on soils too poor or too badly tilled to produce most other crops and seems to be less affected by soil than by season. It is not desirable, however, to attempt to grow buckwheat on very rich soils, as under such conditions the crop frequently lodges badly. This ability to produce fair crops on poor soils and under indifferent cultivation has led to buckwheat being often considered the poor farmers' crop. The crop lends inself well to the farmer who lacks capital to secure timely labour and to wait for returns on investments in tillage and manures.

Manures.—Manures are not usually applied to land intended for buckwheat. Moderate applications of manures, however, on poor soils results in largely increased yields. When grown on very poor soils buckwheat responds well to moderate dressings of even low-grade manures.

Preparation of Soil and Sowing.—Buckwheat is usually sown on roughly prepared land. Early ploughing of the land so as to allow of several harrowings at intervals of two weeks and a thorough settling of the soil nearly insures the maximum crop.

Buckwheat is sown at the end of June or early July at the rate of 50 lbs per acre when broadcasted or 12 to 25 lbs. when drilled. Harvesting is done in October.

Harvesting.—The seed sheds easily when ripe and it is, therefore, necessary to get on with the harvesting operation

early. When harvested early the straw also is more nutritious. To avoid shelling and the loss of the more mature grains it is preferably cut early in the morning while damp from dew or during damp cloudy weather. It is usually allowed to lie a few days in swath. Threshing should be done on a dry, airy day, so that the grain would shell easily.

The average produce on suitable soils may be taken to be 1,200 lbs. of grain per acre.

Composition.—The following table compiled by Hunt shows the composition of the grain, straw, flour, middlings and hulls of buckwheat :

	Grain.	Straw.	Flour.	Middlings.	Hulls.
Water	12 6	9·9	14·6	12 7	10·1
Ash	2·0	5 5	1·0	5 1	2·0
Protein	10·0	5·2	6 9	28 1	4·8
Crude Fibre	8·7	43·0	0·3	4·2	44·7
Nitrogen free-extract ..	64 5	35 1	75·8	42·4	37·7
Fat ..	2·2	1·3	1·4	7·6	0 9

Owing to its thick heavy hull buckwheat contains a larger percentage of crude fibre than the cereal grains. The percentage of protein and nitrogen-free extract is somewhat lower than in the case of wheat. Buckwheat flour contains only about two-thirds as much protein as wheat flour. The straw of buckwheat contains a somewhat higher percentage of protein and crude-fibre and a lower percentage of nitrogen-free-extract than wheat straw.

Uses. -The grain of buckwheat is very nourishing. Almost all of the buckwheat produced is used in the making of buckwheat flour, which commands a high price on the market Buckwheat flour is whiter than that made from wheat and has a peculair mealy feel to the hand that enables one to readily distinguish it from wheat flour. The middlings, a by-product of the flouring process, is much sought by dairymen as food for dairy cows because of its high content of nitrogen. The hulls have little or no value.

Buckwheat grain is much relished by poultry and has the reputation of being of special value in egg production.

The green leaves can be cooked and eaten as *sag*.

"A SUGGESTION FOR THE SALVAGE OF DRY COWS IN THE CITIES IN U. P."

BY

M. J. ZACHARIAH, B. Sc. (AG.)

Manager, Station Dairy, Ranikhet.

Any scheme of improvement connected with village people must be so planned that the required improvement should come from within the villages and not be imposed on them from outside. Best results cannot be obtained if subsidized as a Government measure. An improvement programme can only then effect permanent changes in the village. Hence an attempt should be made to induce mutual or self-help for a permanently better standard or mode of living. Once a villager has experienced as a result of actions on his own convictions that a particular method is beneficial he follows it. However, because of his lack of knowledge technical guidance is needed. We have to aim at a scheme of organisation therefore, whereby the villager is benefitted by the Government and the Government in turn by the villager.

Again, the success of a scheme means recurring profitable returns for the money and effort invested in it. Without such returns the scheme may live but can never expand. The factors which effect these economic returns must therefore be given first consideration. Remembering this a scheme for the salvage of dry cows in the cities should be tried, in the beginning, only with the cattle caste, the *gwalas* whose only occupation is the rearing of cattle.

Before embarking on the scheme we have to analyse the reasons why these dry cows are sold to butchers. There are two chief reasons: (1) The *gwalas*' paltry means; and (2) the unprofitableness of the cows.

As regards the first there may be animals that would prove profitable if they could be maintained throughout their dry period until they freshen again. Too often good cows are sold because the paltry means of the villager does not permit him to feed and care for the animals while dry. A solution for this has the double advantage of preserving the good cows of the province as well as enabling the villager to co operate with the Government. He would thereby appreciate, sooner or later, the help that the Government was giving him.

The second point offers tremendous difficulties. Maintaining unprofitable cows means a great loss to the villager, the Government or both. It has beed suggested by some that *gaushalas* could be used for the boarding of dry city cows. If *gaushalas* can do anything along this line, they can only be used successfully for the boarding of the cows that are unprofitable to the villager and hence to be sold to butchers.

In order to solve the first problem, namely the poverty of the *gwalas*, and their inability to keep the cows during their dry periods, the first step is to find a means whereby the cost of feeding animals may be lowered from what it is in the city. For this we suggest a colonization of the *gwalas* near the city, but far enough from the city, so that their keeping of the animals will be within their paltry means. Also an attempt should be made to keep enough animals so that the volume of milk produced will be large enough to justify the use of improved equipment. Dr. Norman C. Wright, in his Report on the Development of the Cattle Dairy Industries of India, in chapter II, page 15, says: "One essential step in any attempt to improve methods of production is, I believe, the combination of producers on a village industry basis where the handling of large quantities permits of the employment of more specialised labour and where the output is sufficiently large to justify the use of improved types of equipment."

To start with, in the United Provinces, a place in the forest land at Tuhi, two miles from Cawnpore, situated on

Hamirpur Road, would be a suitable place The Agricutural Department should take on lease two to three thousand acres of this forest land. On this the city *gwalas* of Cawnpore should be colonized and linked together into a co-operative society.

Here the Government should erect barns, paddocks, quarters of residence, as well as feed stores, wells, and a dairy building. From each member of the society a monthly charge should be made for the facilities; and also the society should be charged by Government for the dairy buildings and other equipment. The charges should be moderate and should be so distributed over a number of years that the original cost to Government would be recovered.

The Society should work on the following basis:

1. All members of the society should be required to keep their cattle in sheds leased to the society by the Agricultural Department.

2. Milking should be done at appointed hours under the supervision of the Government staff.

3. Milk of individual cows as well as that belonging to individual *gwalas* should be recorded by the society staff.

4. There should be a separate department for retailing milk and its products. All milk of the cattle of the members should be handed over to this department. The retailing department should give a few seers to each member for his domestic use, as allowed by the society. This amount should be deducted in the end of the month from each member's supply to the dairy. Milk should be supplied to the retailing department at a rate fixed from time to time by the society.

5. The members should be paid for their milk supply in the month following that in which it was supplied, at the rate fixed by the society.

6. The balance sheet of the retailing department should be prepared at the close of the financial year and any profit gained in this section be distributed to the members; if any loss is incurred it should be met in the succeeding year. The rate for milk supplied to the retailing department should be fixed for the succeeding year on this basis.

7. The society should maintain a cattle food depot for purchasing feed and fodder for retailing to the members. The feed should be sold to the members at cost price plus a minimum charge which will cover the recurring expenses of the cattle fodder depot and may leave a little profit to the society.

8. The cost of the feed and fodder supplied from the cattle food depot should be recovered every month from milk bills of each member.

9. Member should keep their animals and look after them and be responsible for their milking. All animals should be brought to a fenced area at dusk and the gate of it should be locked and opened only at the time of milking by a chowkidar who should watch and allow the milker to get in.

10. Each member should be provided with quarters for which a charge is to be made each month.

11. The Government should immunize all animals against rinderpest, etc.

12. The Government should also be responsible for the breeding programme of the animals of the society.

13. There should be a general annual meeting of the society to elect a secretary and a panchayat of 5 members, including the Secretary, to assist him in settling quarrels, etc.

14. The Secretary should have the power to enter into an agreement on behalf of the members of the society with the Government for the working of the society.

The success of any scheme depends not only on the money invested but to a great extent on the honesty, and unselfishness and the good moral character of the personnel. Hence special care should be taken in choosing and deputing the right men for the work.

The number of cattle in British India increased from 146 millions in 1920 to 154 millions in 1930.

HYBRID VIGOUR IN JAUNPUR MAIZE

BY

R. SYED

Introduction :—Hybrid vigour in sexually-reproduced organisms is well known indeed. Suffice it to mention that the phenomenon is attended with increased yield. A number of American and other workers have clearly demonstrated that maize hybrids often remarkably out-yield one or both parents, but corn varieties, single crosses inbred variety crosses and double crosses, differ in their relative variability. In sweet corn breeding, however, single crosses are supposed to have a decided advantage over either inbred variety crosses or double crosses. (12) The response of Indian varieties of corn to this phenomenon does not appear to have received the attention it deserves and hence an attempt has been made here to study the effect of single crosses on the yield of Jaunpur varieties of sweet corn.

Material and Method :—Several pure lines that reproduced themselves in relatively true form for their inherited characters year after year were obtained on being selfed by controlled hand pollination Jaunpur maize among these isolated lines appeared to be more promising than others and hence some reciprocal crosses were made between a few white and yellow-kernelled selections.

The parent as well as the progeny were studied for such characters as plant height, number of nodes per plant, length and breadth of leaves, the length of the cob, the circumference of ear at butt and tip, the number of kernel—rows per ear, and the number of grains per row. The height of the plants was taken from soil surface to the tip of the tassels at regular intervals of 14 days after sowing; the length of leaves was measured from the base of ligule to their tip and the breadth was taken at the broadest point; the ear measurements were taken from butt to tip; the circumference of the ear at butt and tip was measured two inches from the ends and the number of rows were counted three inches from butt (13).

The hybrids were also tried in 0·0118 acre strips against bulk selections of two Jaunpur varieties which were originally grown for isolating the parents. There were 10 replications and the treatments so far as possible were fully randomised. The total yield of each variety from all the 10 replications was considered to be an outturn from 0·118 (total area of 10 strips) acre plots for the final interpretation of these results. And for simplification the relation between these treatments was found out by supposing the yield of Jaunpur yellow variety as 100 maunds.

Experimental Results:—The data regarding pre-harvest observations are given in Table I, whereas the actual size of the parents and hybrid ears are presented in figure 1.

TABLE I

Statement showing average measurements of plants, leaves and flowering dates.

Colour of Cob.	Height 14 days after sowing.	Height 28 days after sowing	Height 42 days after sowing.	Nodes per plant.	Length and Breadth of leaves.	Flowering	
						Tassel	Silk
Yellow	40·3 Cms.	101·1 Cms.	205·5 Cms.	12	70·0 Cms. 10·2 Cms.	30th July	5th Aug.
White	39·6 Cms.	95·4 Cms.	198·1 Cms.	14	81·5 Cms. 8·4 Cms.	30th July	6th Aug.
Hybrids	57·7 Cms.	151 9 Cms.	278·2 Cms.	16	83·2 Cms. 10·4 Cms.	24th July	29th July

Besides general vigour and comparatively dark green colour of the hybrid plants, it is evident from the above data that the hybrids are decidedly taller, possess greater number of nodes and are about a week earlier in flowering than their parents.

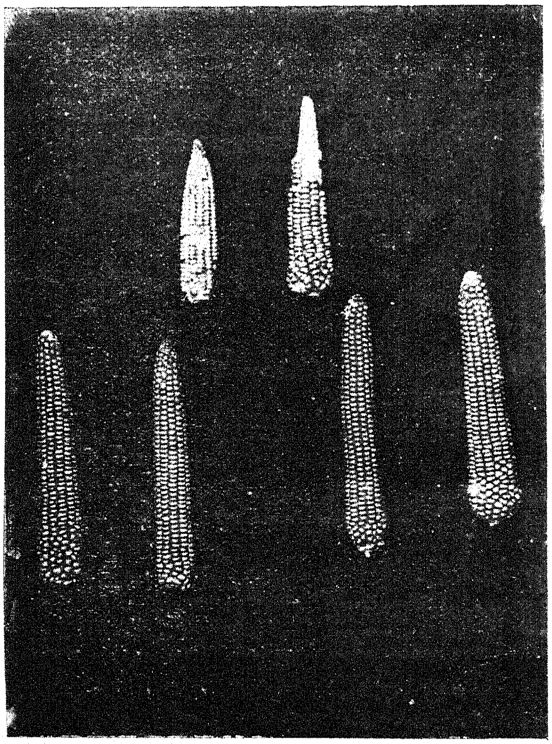

Fig. 1. Representative Ears of selfed and First Generation Crosses.

Above : – Parents. Right. Yellow Kernelled:—2.5″ top without kernels.

Length 7·5″; Butt circum. 5·0″; Tip circum. 3 2″; Rows 10·0; Grains per row 23.

Left. White Kernelled :—1·5″ top portion without kernels.

Length 6·4″, Butt circum. 4·25″; Tip circum 3·8″; Rows 12 0″; Grains per row 29.

Below :—Hybrids. All hybrids completely full of kernels.

Length 9·5″; Butt circum. 5·5″; Tip circum. 4·5″; Row. 12 0, Grains per row 48.

From the above data of figure 1, one could easily note the highly significant differences in yielding capacity of parents and the hybrids. These results are further confirmed from the behaviour of hybrids under field conditions which is the ultimate test of the superiority of hybrids over the parents. The actual results are furnished in Table II.

TABLE II

Statement showing comparative yield of parents & hybrids

Nature of Ear	Area of each plot.	Actual yield of ear per plot.	Yield of ears per acre.	Percentage on yellow.
Yellow ..	0·118 acre	2·13 Mds.	18·05 Mds.	100·00
White ..	Do.	2·68 Mds.	22·71 Mds.	125·82 (125·82)
Hybrids ..	Do.	3·59 Mds.	30·40 Mds.	168·54 (168·54)

The data presented above when subjected to statistical analysis gave significant results, this exhibiting the distinct superiority of the hybrids over both the parents. This is also evident from the data given (in Table II especially) in the percentage column where the hybrids have out yielded both the parents very remarkably.

Conclusion :—In concurrence with several workers mentioned below it is concluded that Jaunpur maize like other foreign varieties of corn responds to the phenomenon of hybrid vigour, the beneficial effects of which are observed in the form of comparatively good general health of the crop as a whole and in an increase in such metrical characters as height of plants, the length and breadth of leaves and the number of nodes per plants. There is also a remarkable difference in the dimensions of hybrid cobs and consequently the increase in out-turn is significant.

Acknowledgments:—My thanks are due to Mr. T. S. Sabnis, I. A. S., Economic Botanist, U. P., for his kindly interest in suggesting some very useful literature on the subject.

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The Royal Agricultural Commission of India, as far back as 1932, emphasised the point that unless adulteration was stopped, no honest man could take to the business of selling milk.—*Chaudhnri Mukhtar Singh.*

"Broodiness in hens is an inherited characteristic. To help eliminate it from the flock, retain each year for breeders only the yearling hens that do not show the broodiness tendency."—*The Furrow.*

A Book Review

"Indian Agriculture": Mr. R G. Allan, Commissioner of Agriculture, Baroda State, has in a very brief and compact space put a lot of most useful information regarding Indian agriculture. It may be termed "a brief survey, or birds-eye view of Indian Agriculture." It is not only valuable for all students in agricultural colleges but will prove of value to government officers and teachers and all others who want to know something of Indian agriculture Mr. Allan has given to us the cream of his wide experience and long experience of Indian agriculture. He also gives us what few men are capable of giving (and this is not done directly; but there emerges his philosophy regarding Indian agriculture. He has thought and brooded much on the subject and indirectly out of a full mind he gives us valuable material and observations.

Because the book is so brief and concise much that one would like to see in it is not there; for instance as head of an American institution greatly concerned with the improvement of India's agriculture, I wish that Mr. Allan had found space to put in the fact that nearly forty years ago Mr. Phipps an American gave to India through Lord Curzon a gift of $150,000, about four and a half laks of rupees. This I believe gave a start to what was known as the Imperial Agricultural Research Institute at Pusa, and which is now in Delhi. This gift marks the real start for widespread interest in Indian agriculture. Again I think Mr Allan would have made a much more readable book had he broken up some of his long involved sentences and made shorter sentences of them. Also I fear I am old fashioned in the matter of English uses "Different to" does not appeal to me as much as "different from". But please do not let these small defects detract from the very valuable service that Mr. Allan has done to those interested in the improvement of India's agriculture Mr. Allan not only gives you the facts as he sees them but the interpretation of those facts, with which interpretation in all cases I am not in complete agreement, although I am in agreement with most of what he says. He has put all lovers of Indian agriculture in his debt in giving us this book, valuable for beyond the selling price of the book.

SAM HIGGINBOTTOM.

A SCHEME FOR THE IMPROVEMENT OF OUR VILLAGES*.

BY

M. A. KOLKHEDE

Chapter VIII.

EDUCATION:

The problem of rural reconstruction is in reality the problem of rural education. Villagers have to be educated into a sense of what is wanting and what is possible to achieve even with their limited sourses. In any programme of rural reconstruction, therefore, education in agriculture, co-operation, industry and sanitation must be given the first and the foremost place. When our boys, girls, men and women are well educated in the above four branches of education they will derive the following benefits:—

1. They will get general knowledge which will help them to earn a living and to get on better in life.

2. Will build up habits of right thinking and doing and will thereby turn their powers into good use.

3. Will eradicate unhealthy and undesirable practices which operate harmfully at present and divide society into pieces.

4. Will develop a sense of self-respect.

5. Will enable them to appreciate the beauties of moral life and acquire faith in the power inherent in goodness.

6. Will give them knowledge of their civic rights and responsibilities and thus make them good and useful citizens.

Now according to the age and need of the people the education of the people may be divided into three parts:—

1. Education of boys.
2. Education of women and girls.
3. Education of adults.

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*Continued from previous issues.

Education of Boys.—At present, the education of our boys is openly neglected, and the little education which is given does not suit to the rural conditions. It is therefore necessary take into consideration the following points while laying a scheme of rural education:—

1. Environment of the school should be that of a good home.

2. Learning to be thought of as new way of behavin g not in storing up of information, but in being

3. Education is life—not divorced from life. School activities to be closely related to the life of the pupil and to the life of the society outside.

4. Flexibility of the curriculum and freedom to develope naturally

5 Interest—the motive of all work. Individually the pupil to be recognised and his aptitudes and interests discovered.

6. The teacher should be a guide and not a task master.

7. Learning by doing.

8. Education expressive of indiginous culture.

There must be a rural school in each village with the following courses of study:—

1. General course in rural education.
2. General course in rural economy, rural sociology and co-operation.
3. Sanitation and Hygiene.
4. Agriculture, Elementary science and Nature's study.
5. Principles and metheds of teaching.
6. Industrial arts.
7. Scout organisation.
8. History and Civics.
9. Music Art and Drawing.
10. Training in leadership.

All the above courses which are well suited to our rural conditions are govern in the form of a short syllabus which is given in appendix No. 6

Education of Women and Girls.—In villages the education of girls has been almost totally neglected. There are no special schools for the girls and the people being very orthodox do not send their girls to boys' school. The need for education of girls is as great as it is for boys Half of our troubles will disappear when the girls receive some education and some good training for their future position as wives and mothers. It is the mother who brings up the children, it is she who feeds and clothes and looks after them. The West has fully recognised the place of women in the education of children. What the West is today is largely due to the part that women have played, as mothers, teachers, and governesses. If we want to stand on equality with Western nations, we also must educate our women, who in their turn will educate their children, both in the homes and in the schools.

At present, women are given the same kind of academic education that is given to men. But now the curriculum of the girls schools in the rural areas has to be prepared according to their needs of the village women and girls. A short syllabus which includes.—

1. Home economy.
2. Sanitation.
3. Personal and social hygiene.
4. Child welfare.
5. Cottages industries, is given in appendix No. 7.

In this task of education of women in rural areas, women from cities and towns will have to take the lead. They must go to their surrounding villages and open a branch of their 'Bhani Mandal' or 'Sharda Mandal'. For the women of labouring classes, they will have to open night classes and develop in them a taste of leadership. They also must teach them some cottage industries which will engage them in dry season.

Education of Adults.—It is the adults' education which, to a great extent, is going to solve most of the present-day

problems, if only it is carried on along the right lines. In our rural areas, the programme of adults' education will have to be divided in the kind:—

1. To meet the problem of illiteracy at the same time providing an education which does not necessarily involve the three R's, as for example education in citizenship, in health and sanitation, in co-operation, in village self-government, and in improving social and religious customs.

2. To promote adult education in the broad sense of the term without attempting to solve the problem of removing illiteracy.

3. To retain the literacy of the people, at the same time providing adult education as mentioned in No. 1.

Merely to teach the people to read and write should not be the aim of adult educatoin, although it will have to be included in it to accelerate our progress. Rapid progress in this movement is possible only when our young men leave their towns and cities and take the noble task of rural reconstruction. For this purpose, educated men from towns should conduct night classes in their surrounding villages and give them the lessons in co-operation, sanitation, agriculture and industry. Government also must help to solve the problem by running cinema and demonstration lorries, by distributing free pamphlets, etc.

Training in Co-operation.—Co-operation must form the first and the foremost item in adult education. It is by co-operation alone that the villagers will be able to improve their condition. They should be given to understand the benefits of co-operation.

Rural Libraries.—This will be a good place to create taste for literacy among the people. In every village there should be a small library which will have some interesting books written in simple language. The books will naturally be written in the local vernacular and will be on subjects like agriculture, co-operation, sanitation, health, Cottage industries, etc. There should be also two or three papers and three or four magazines.

All those who can afford to come in the evening should be called to meet at a central place and the good and

appealing extracts from the papers and magazines should be read out for them. Nowadays, Radios are available and must be used frequently. They are not very costly and may be either supplied by the Government or by the Local Boards. These radios will serve the best purpose in influencing the villagers in a particular direction.

The Rural Teacher and his Work.—The place of the teacher in a rural reconstruction is of the first importance in the improvement of our country. The future of the village lies in his hand and has an immense opportunity for good and for evil too. He must raise the banner of '*Uplift*' in his school and village. The task will be long and hard, his journey always uphill, but his reward will be great—the affection and the respect of every one parents as well as children, and a happy contented village. The idea of the village teacher should not be to produce potential B.A 's and LL.B.'s but to produce, intelligent, healthier and happier villagers who will prove to be the worthy sons of this Motherland. 'Health is Wealth' and first lesson, therefore, should be to teach the healthy habits to the boys. The teacher must convince the boy and his parents that things can be put right, the land made to produce more, and the village made healthy, comfortable and tidy For a long time, the villagers will refuse to believe that any improvement, either in their farming or in their conditions of living is ever possible, and will mock at the idea that the teacher has really got anything practical to teach them. But by example as much as by precept, the teacher must convince the people that his aim to turn out, and that he really turns out clean, healthy, happy and intelligent boys with a sufficient knowledge of reading, and writing to improve their surroundings.

The teacher must become a true village leader, a centre of light and culture, whom the people trust and to whom they refer their problems and consult when they are in doubt or difficulty. School is the barrack square where the recruits are trained for life's great battle against dirt, disease, idleness, poverty and ignorance. The small boys and girls are the budding citizens in whom the best hope of future

India lies. They are quick and ready learners and free from any evil customs and traditions If, therefore, we sow the precious seed of rural reconstruction in the village school, we shall get the sweet things in the village in the future. Now the problem, naturally arises about the training of the teachers themselves. This training can very well be received from any one of the following institutions:—

1. Rabindranath Tagore's Institute of Rural Reconstruction, Srineketan.
2. The School of Rural Economy, Gurgaon (Punjab).
3. The Rural Reconstruction Centre, Kosamba, (Baroda State), here various short courses are available within a short time and at a less cost. A short syllabus of these courses is therefore given in appendix No. 7.

All the above three institutions give perfect knowledge of the art of rural reconstruction. Provincial Governments and Local Bodies should therefore send their some young men and teachers to any one of these institutions. I would also like to request our young graduates to go and study at any one of these institutions, especially Shantineketan of Tagore for a year or two.

Appendix No. VI.

A Short Syllabus for the Rural Schools :

I. Co-operation and Rural Economics.

1. Resources and economic condition of the locality. The causes of the poverty of the peasants.
2. Means of economic uplift.
3. The meaning of co-operation.
4. Credit.
5. Interest.
6. Liability, limited and unlimited.

7. Credit Societies.
8. Thrift Societies.
9. Preliminary history and advantages of co-operation in Europe and U.S.A
10. Co-operative Societies of various types, specially useful for rural population.
11. Preliminary knowledge about the accounts of co-operative societies.
12. Consolidation of holdings and its advantages.

II. *Practical Agriculture for Local Conditions* :—

1. Use of all implements, country and improved.
2. Soils, manures, and field operations.
3. Simple physiology of plant life.
4. Field pests and their control.
5. Plant diseases and their remedies.
6. Cultivation and care of all *Rabi* and *Kharif* crops, all important vegetables, fruits and flowers.
7. Some idea about the planning and laying out of a farm.
8. Cattle, their importance, maintenance and improvement.
9. Value of farm-yard manure and urine earth, their preservation and use.
10. Preservation of fodder by making silage.
11. Practice of keeping farm accounts.
12. Agricultural education in rural primary schools.
13. Methods of securing, storing and supplying of improved seeds to villagers.

III. *Simple Training in Veterinary Science and Cattle Breeding* :—

1. Value of cattle, causes of deterioration and their remedies.
2. Proper housing and feeding.

3. Good hygiene and sanitation.
4. Preliminary knowledge of the physiology of cattle.
5. Important and common diseases and epidemics, causes of their spread, and methods of prevention and cure.
6. First aid to cattle.
7. Castration and its value in cattle breeding.
8. Cattle breeding Co-operative Societies.
9. Improvement of pasture land.
10. Simple medicines, their actions, uses and doses.

IV. Village Hygiene and Sanitation :—

1. Importance of air, water and food to human life.
2. Personal hygiene, house cleanliness.
3. Common epidemics, causes of their spread, their prevention and cure.
4. Village cleanliness, upkeep of wells and ponds.
5. Health and its importance

V. First-aid :—

1. Theoretical and practical work, in treating some of the common diseases.
2. Preliminary knowledge of human body and its physiology.
3. Methods of combating epidemics like cholera, malaria, plague, etc.

VI. Rural Education :—

1. Illiteracy in villages, and adult education.
2. Necessity of compulsory primary education.
3. Importance of village library.
4. Rural uplift, songs and dramas.

VII. Social Service :—

1. Need and importance of scouting, the history of the movement and the advantages of the patrol system.
2. Training Camps.
3. Duties towards the villagers.

VIII. Simple Lessons in Government and its administration:—

1. Knowledge of the various land measurements, settlement work, etc
2. Preliminary knowledge about the administration of the various local bodies.
3. Village Panchayats, their scope and work.

IX. Training in Cottage Industries :—

1. Spinning and weaving.
2. Poultry farming.
3. Sericulture.
4. Soap making, rope making, etc.

Appendix No. VII.

A Short Syllabus for Rural Schools for women girls:—

The training in the schools must include the following subjects :—

1. Vernacular language.
2. Domestic economy (cooking, house cleaning, washing of clothes, etc.)
3. Arithmetic.
4. Hygiene (personal and social) and sanitation.
5. Needle work and knitting, the use of the sewing machines.
6. Embroidery training.
7. Simple First-aid.
8. Baby and infant welfare.
9. Singing, games and physical exercise.
10. Gardening and making toys.
11. Importance and advantages of co-operation.
12. Various cottage industries, *e. g.* preparation of different sweets, pickles, silk and woollen clothes for small boys, etc.
13. Training in Mid-wifery.
14. Spinning and weaving.

REPORT FROM THE DEPARTMENT OF AGRICULTURE, U. P.

I—Season.—The rainfall during August, 1940, was general and above the normal in most districts, only 15 districts recording below the normal. Rain is still needed at places where it is deficient. A statement showing the districtwise distribution of rainfall is appended.

II—Agricultural operations.—Agricultural operations are generally up-to-date. Preparation of land for *rabi*, transplantation of late rice and weeding of *kharif* crops are in progress.

III—Standing Crops and IV—Prospects of the harvest.—The condition of the standing crops is generally satisfactory and the prospects are favourable.

V—Damage to crops.—Some damage to crops is reported due to excessive rains and floods in certain districts and for want of rain in the Jaunpur and Fyzabad Districts.

VI—Agricultural stock.—The condition of agricultural stock is satisfactory. Cattle diseases have increased as compared with the previous month. The following figures are supplied by the Director of Veterinary Services, United Provinces, Lucknow.

Diseases	July, 1940		August, 1940	
	Affected	Death	Affected	Death
Rinderpest	1,732	689	1,294	689
Foot-and-mouth	1,975	2	4,210	42
Hæmorrhagic Septicæmia	1,031	817	3,155	2,350

VII.—Pasturage and fooder.—Fodder and water are reported to be sufficient everywhere.

VIII.—Trade aud prices.—Prices of the chief food grains show a tendency to rise. The following figures

compare the retail prices in rupees per maund at the end of the month with those of the preceding month :

			End of July, 1940.	End of August, 1940.
Wheat	...	...	3·517	3·631
Barley	...	...	2·659	2·707
Gram	...	...	3·317	3·323
Rice ...	...	...	5·191	5·263
Arhar dal	...	...	4 207	4·264

IX.—Health and labour in rural areas.—The condition of the agricultural and labouring classes is satisfactory. Cholera and small-pox are reported from some district.

For the Month of September, 1940

I—Season.—The rainfall during the first fortnight and the last week of September, 1940, was very light, particularly in the Meerut, Agra, Rohilkhand, Allahabad and Jhansi Divisions. In the third week it was general and proved beneficial to the crops For the province as a whole the rainfall was below the normal. Only the Gorakhpur District recorded rainfall above normal.

II—Agricultural Operations.—Preparation of land for *rabi*, harvesting of *kharif* crops and picking of cotton continues.

III—Standing crops and IV—Prospects of the harvest.—The condition of the standing crops is generally satisfactory and the prospects are favourable, but more rain is needed particularly in the western districts. The general yield of *kharif* crops for the province is estimated at 13 annas in the rupee.

V—Damage to crops.—No serious damage to crops is reported but rain is still needed in some districts.

VI—Agricultural stock.—The condition of agricultural stock is satisfactory. Cattle diseases are reported from some districts and the following figures of cattle mortality have been furnished by the Director of Veterinary Services, United Provinces.

Diseases	August, 1940		September, 1940	
	Affected	Death	Affected	Death
Rinderpest	1,294	689	2,288	1,383
Foot-and-mouth	4,210	42	8,184	65
Hæmorrhagic Septicæmia . .	3,155	2,350	2,908	2,057

VII—Pasturage and fodder.—Pasturage and fodder are reported to be sufficient every where.

VIII.—Trade and Prices.—Prices of the chief food grains show a tendency to rise except that of rice. The following figures show the retail prices in rupees per maund during the months of August and September, 1940.

	End of August, 1940	End of September, 1940.
Wheat	3·631	3·705
Barley	2·707	2·762
Gram	3·323	3·418
Rice	5·263	5·112
Arhar dal	4·264	4·277

IX.—Health and Labour in rural areas.—Adequate employment is reported to be available for the labouring and agricultural population. Cholera is still reported from a number of districts.

ERRATA SLIP FOR THE ARTICLE

"CROP IMPROVEMENT BY HYBRIDISATION"

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Page 205. Para 2, Line 3. Read 'felt' for 'left'.

Page 209. Para 2, Line 2. Read "This is exemplified . . . . used" in inverted commas and insert (Sethis and Mehta 1936).

Page 209. Under Bibliography add the following :

5. R. L. Sethi, B. L. Sethi and T. R. Mehta 1936. "Agriculture and Livestock in India" Vol. VI, Part IV, July 1936.

6. "Recent Advances in Plant Breeding" by Hunter and Leake, 1933.

M. P. SINGH.